Representative of Every Interest

# The Citrus Industry

Representing No Special Interest



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## Florida's Growers Look To The Future

Someone once said "Life Is Not Always A Bed of Roses," a saying which we are certain will find ready concurrence among Florida's citrus and vegetable growers at this time.

However, these same growers many times before have met and overcome ravages of pests, drouths, floods, economic set-backs and many other deterrents to prosperity.

So in surmounting the losses caused by the recent freezes . . . as they surely will . . . Florida's growers will only be carrying on a tradition which is as old as the fruit and vegetable industry in this state.

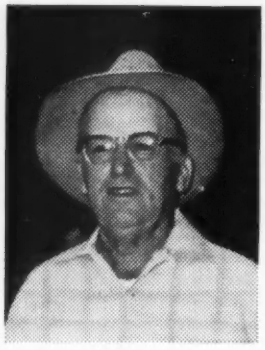
We tip our hats to the indomitable spirit of this group of business men, who have already started the work of revitalizing their properties in preparation for future growing seasons.

VOL. 39 — NO. 3 MARCH, 1958 BARTOW, FLORIDA

# Citrus Growers Report

## *"Good rust mite control" with* DITHANE Z-78

(ZINEB)



**"One of the best sprays I've ever used . . ."**

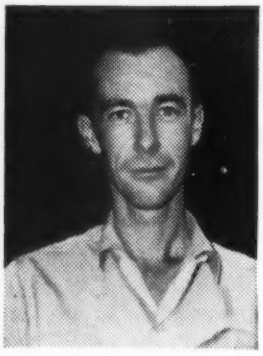
I have over 600 acres and have been in the citrus business for over 38 years. I have used two applications of DITHANE Z-78 this season and find it one of the best sprays I've ever used to control rust mites, on leaves as well as fruit. There is no danger whatever in burning fruit in hot weather with DITHANE as is often experienced with sulfur. I believe I am getting smoother quality with DITHANE.

A. O. ROBERTS
Howey, Florida

**". . . superior rust mite control."**

By using DITHANE Z-78 this past summer for rust mites, we were able to compare its control with sulfur. DITHANE clearly demonstrated its ability to give superior rust mite control.

WILLIAM H. GIBB, JR.
Gibb Groves, Clermont, Fla.



**". . . lasting control . . . can be used with oil."**

I now use DITHANE Z-78 for rust mite control on 650 acres of citrus and prefer it over sulfur because it gives lasting control and because it can be used with oil. DITHANE Z-78 is also easier on equipment than sulfur.

E. ALLEN HALEY, JR.
Orlando, Florida

J. H. BARNHART
Mount Dora, Florida

**"DITHANE Z-78 has given me very good results . . ."**

Last July, I included DITHANE Z-78 in with my regular summer scalecide for "greasy spot" and rust mite control, and it has given me very good results; in fact, I have not used any other material since applying this.

Include DITHANE Z-78 (zineb) in your own dormant or post-bloom sprays for exceptional double-duty control of (1) rust mite and (2) "greasy spot." To benefit from its high initial kill and long residual activity, it is essential to obtain thorough coverage at the recommended dosage.

Get DITHANE Z-78 from your dealer . . . ask him for more information on this double-duty zineb fungicide.

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# DITHANE Z-78

R. M. Pratt

# Citrus Insect Control

R. B. Johnson

## For March 1958

R. B. JOHNSON*
R. M. PRATT
W. L. THOMPSON
Florida Citrus Experiment Station, Lake Alfred

W. L. Thompson

Until we know what the weather will be like in March we can only guess what the insect and mite situation will be. It seems probable that warm weather will return by early March at the latest, and with the generally abundant soil moisture been increasing slowly but steadily during January and February. The population will be high this spring and severe infestations with resulting leaf injury and defoliation will occur in many groves. Grapefruit groves especially should be watched for in-

SCALE AND MITE ACTIVITY BY DISTRICTS*

| District | Purple Scale | Red Scale | Purple Mite | Rust Mite on leaves | Rust Mite on fruit |
|---|---|---|---|---|---|
| West Coast | 2.27 | 0 | .28 | 1.23 | .64 |
| Indian River | 1.74 | .11 | 1.40 | .54 | .28 |
| Upper East Coast | 3.14 | —.29 | .57 | 0 | —1.00 |
| Gainesville | 2.67 | .16 | 0 | —.17 | 0 |
| Orlando | 2.52 | —.16 | .29 | .12 | 0 |
| Brooksville | 2.44 | —.07 | .33 | 1.47 | .66 |
| Ridge | 2.38 | .75 | .88 | .92 | .42 |
| Bartow | 2.88 | —.09 | .91 | 2.00 | 1.20 |
| State Average | 2.41 | .90 | .63 | .80 | .42 |
| Last Year | 3.51 | 2.71 | 1.41 | 1.68 | 1.39 |

* Second week in February. Activity is computed from populations, amount of hatching of scales, and number of groves with increasing or deceasing infestations. Activity is considered high if above 4.0 for purple scale, 3.0 for red scale, and 1.5 for mites.

supply a vigorous flush of growth can be expected on all but the most severely damaged trees.

The population of all the major pests was at a low level in February.

Purple scale will increase rapidly on the new foliage and will be a problem in many groves this spring. Red scale, on the other hand, is at an extremely low level and will not recover rapidly. It will not be troublesome in the spring in many groves, but infestations are expected to be heavy in the fall.

The purple mite situation will depend entirely on the amount of rainfall. Following the cold weather a severe outbreak would be expected if the spring weather is dry, but if rainfall continues above the average it will hold the population in check. Some increase in Texas citrus mite population is expected in March.

Six-spotted mite infestations have been increasing slowly but steadily during January and February. The population will be high this spring and severe infestations with resulting leaf injury and defoliation will occur in many groves. Grapefruit groves especially should be watched for infestations of this mite. The earliest infestations will be found on rough lemon sprouts and around old colonies of purple scale.

Rust mite will not be particularly abundant in March, but it should be remembered that where they are numerous they can cause leaf drop as well as fruit injury.

If the new flush of growth matures rapidly, as expected, aphids will not be particularly troublesome.

Dead wood is present in most trees and will produce an abundance of melanose spores. If rainy weather occurs while the leaves are young and in a susceptible stage, infection will be heavy and may cause serious loss of the new foliage as well as injury to fruit.

### SPRAY PROGRAM

For the past several years it has been possible to forecast by the end of February when post-bloom spraying would begin. This year it is different. Repeated freezes and continuous cold weather have placed the issue in doubt. Most of us will agree, however, that the post-bloom period will not begin in March and will be unusually late. This leaves us not with the problem of what to do at post-bloom time but with the problem of what to do during the weeks to come before post-bloom.

In more normal previous years when the post-bloom period was expected to begin in late March, growers were warned to keep pre-bloom spraying to a minimum in order to prevent unnecessary damage to immature foliage. This is still a good idea, but severe freeze damage and the anticipated delay in post-bloom spraying make it advisable to modify this rule somewhat. Two or three problems may make it necessary to spray before bloom when some mechanical damage to succulent foliage can be expected. These problems will be melanose on partially or wholly defoliated trees, rust mite where large acreages are involved, and six-spotted mite.

**Melanose Control:** Whenever a large portion of the foliage has been lost for any reason the primary aim of the grower should be to help his trees replace the foliage they have lost. One good way to do this is to control melanose, because this disease infects the spring flush of new foliage causing severe distortion of the leaves and leaf drop. These things will occur if there is sufficient rain to cause melanose infection of leaves.

Trees over eight years old, old enough to be infected with melanose, should be sprayed with a copper compound when the new foliage is about one-half developed if they have been partly or completely defoliated. Where large acreages must be treated it is advisable in order to complete the job to start spraying earlier, and to spray the less seriously defoliated groves first. Neutral copper compounds are preferred for this purpose because they leave a minimum of useless residue and are easy to handle, but copper sulfate (blue stone) and lime is just as effective. Regardless of the copper compound use enough to supply 3/4 pound of metallic copper per 100 gallons. Zineb and other non-

(Continued on page 5)

* Written February 21, 1956. Reports of surveys by Harold Holtsberg, Fort Pierce; J. W. Davis, Tavares; K. G. Townsend, Tampa; T. B. Hallam, Avon Park; and L. M. Sutton, Lake Alfred.

## CITRUS INSECT CONTROL FOR MARCH 1958 . . .

(Continued from page 3)

copper materials are not effective against melanose.

Do not use copper compounds with lime-sulfur.

This pre-bloom copper spray is only an emergency measure to protect new foliage on defoliated trees and is not needed on undamaged or only slightly defoliated trees. Furthermore, this spray will not protect the next crop of fruit from melanose infection and should be followed by a post-bloom copper spray wherever bright fruit is desired.

**Rust Mite Control:** Although rust mite are now at a very low level and will undoubtedly remain at a low level until some time after bloom, it will be advisable to spray some groves for their control during March. Where the acreage is so large that post-bloom spraying cannot be completed in 2 or 3 weeks, rust mite frequently build up to injurious numbers on the young fruit before they can be sprayed. One good way to prevent this build-up during the post-bloom period is to apply a pre-bloom spray on that part of the acreage that has the most rust mite. Then, by applying the post-bloom spray to the remaining groves first, the entire acreage can be protected. Wettable sulfur at 10 pounds per 100 gallons or sulfur dust are preferred for pre-bloom rust mite control. Zineb at ½ pound per 100 gallons may be used if preferred. Either sulfur or zineb will give satisfactory control of rust mite in this spray. It is advisable to use wettable sulfur rather than zineb if copper is to be used in this spray for melanose control.

**Six-spotted Mite Control:** This mite may become sufficiently numerous to distort foliage and cause severe defoliation in some groves, especially grapefruit, during March. This need not occur if the mites are detected early enough to apply control measures before damage occurs. Six-spotted mites are first found on lemon sprouts and around masses of purple scale. Check for this mite in these locations now and plan to spray when they begin to spread to other foliage and increase in numbers. Any of the miticides: DN Dry Mix No. 1, Systox, ovex or aramite are effective against the six-spotted mite, but do not use DN Dry Mix on young foliage. Lime-sulfur at 2 gallons per 100 gallons of spray is also effective but should not be used with copper compounds. All of the miticides mentioned above may be used with copper compounds for melanose and sulfur or zineb for rust mite.

**Purple Mite and Texas Citrus Mite Control:** If either purple mite or Texas citrus mite become numerous enough to injure foliage to a greater degree than could be expected from the force of the spray they should be controlled, especially on partially defoliated trees. Control will be less important and may be delayed until post-bloom on trees with normal foliage if soil moisture remains adequate. As long as the weather remains cool, satisfactory control can be expected from Systox, ovex, or aramite, but none of these materials are effective during hot weather.

Three new miticides, Tedion, Trithion, and Kelthane are now available for use on trees without fruit, but must not be used wherever the crop is present. Of these three, Tedion is the most effective during hot weather. For details about these miticides, refer to this article in the January issue of **The Citrus Industry.**

**Scale Control:** It will not be advisable to spray for scale control during March. However, an excellent clean-up of scale can be obtained on defoliated trees.

Details of spray schedules and the various materials used will be found in the "Better Fruit Program" and this should be consulted to determine which materials may or may not be combined. For further information, consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

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The appointment of 10 members and alternates to the Valencia Orange Administrative Committee to serve under the California-Arizona Valencia orange amended marketing agreement and order program for the term Feb. 1, 1958 to Jan. 31, 1960, was recently announced by the U. S. Deparement of Agriculture.

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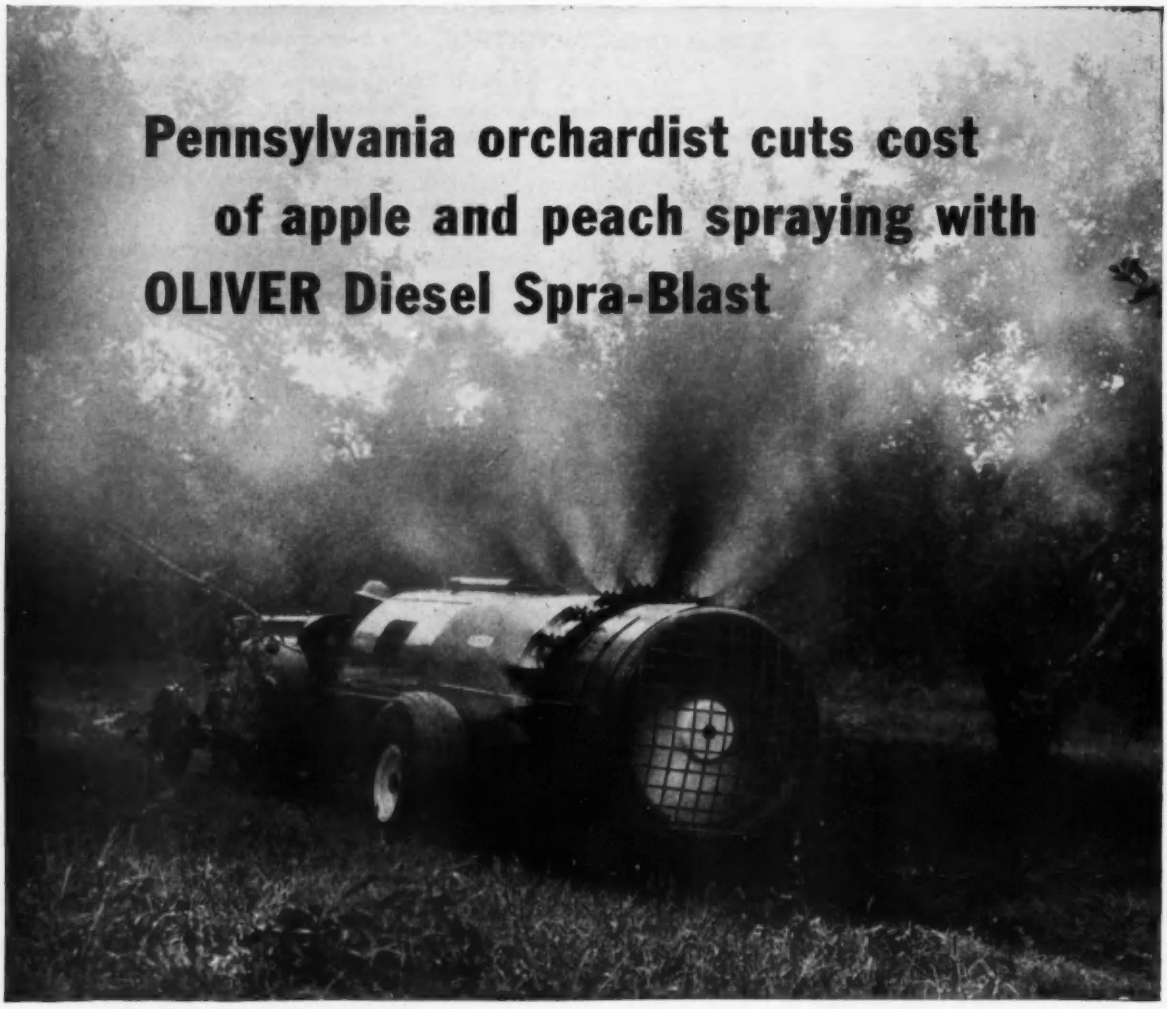
**"Trouble is, everybody's going over my head!"**

# Pennsylvania orchardist cuts cost of apple and peach spraying with OLIVER Diesel Spra-Blast



"I bought an Oliver diesel orchard and grove Spra-Blast because it reduces my spraying costs... uses only 1½ gallons of fuel an hour... gives excellent yields of apples and peaches with 1X and 3X concentrates. And I like the Tac-Hourmeter—no guesswork about how my sprayer is working."

**Says: Rene Apple**
**Richfield, Pa.**

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# Phosphatic Insecticides Mixed With Oil Emulsions For Scale Control And Their Effect On Fruit Quality

. . . BY . . .
W. L. THOMPSON & E. J. DESZYCK
FLORIDA CITRUS EXPERIMENT STATION, LAKE ALFRED

It is now well known that 1.3 percent oil, the recommended concentration of oil for scale control, depresses solids in the juice of citrus fruit, retards degreening of fruit,

DR. W. L. THOMPSON

and in general, is a shock to the trees. On the other hand, oil is a good scalicide and acaricide and is fairly effective in controlling greasy spot. The organic phoshatic compounds that have been tested for scale control neither effect solids nor retard degreening of the fruit, and they are not so likely to have an adverse effect on trees.

It was believed that a combination of reduced dosages of phosphatic compound and oil emulsions might retain the advantages and minimize the disadvantages of both. Thompson, Johnson, and Sites (4) reported that a mixture of 1 pound of 15 percent parathion per 100 gallons plus .65 percent oil controlled scale and purple mite without depressing solids or retarding degreening of fruit as much as 1.3 percent oil. Later work (5) showed that the lower concentration of oil with parathion was about as effective as the higher concentration against greasy spot.

Since parathion was introduced, other phosphatic compounds have been formulated. Johnson (2) reported that 3 to 5 pounds of a 25 percent wettable malathion per 100 gallons controlled light infestations of purple scale and red scale, but control of chaff scale was not encouraging. Chlorothion, 0-0 dimethyl-0(3 chloro-4-nitrophenyl) thiophosphate, tested by the senior author, also showed promise as a

DR. E. J. DESZYCK

scalicide. Malathion, in various formulations, was included in 14 experiments. Chlorothion was tested in three experiments. In this paper, results of all experiments have been

considered, but the results of only five will be discussed.

## SCALE CONTROL

Counts of third stage female scales were made before and after each treatment. The figures in the table under "Corrected Relative Infestations" after spray show the relative size of populations corrected for differences that existed before treatment. This formula was developed by Ebeling (1). Either oil or parathion was used as a standard of 100 for comparison. A figure below 100 indicates a more effective control than the standard material, and a figure over 100 is less effective.

Below each table is recorded the average number of third stage females before and after spray in the plot receiving the standard treatment. Since there were different formulations of each insecticide, dosages are expressed as amounts of active ingredients in the tables, but in the text they are expressed as pounds or pints of the stock insecticide. Wettable sulfur was mixed with the various scalicides for rust mite control in plots where oil was omitted.

In September of 1955, and in March of 1956, experiments were conducted for the control of purple scale, **Lepidosaphes beckii** (Newn.) (Table 1). A 25 percent wettable Malathion was used at 1, 2, and 3 pounds per 100 gallons, with .65 percent oil in an emulsion. Oil emulsion at 1.3 percent oil was used as the standard for comparison. In the September experiment, seven weeks after application, infestations were lower where Malathion was mixed with oil than where the standard 1.3 percent oil was used, but infestations were higher than in the standard after 18 weeks. Malathion at either 2 or 3 pounds per 100 gallons with .65 percent oil was equally effective. Even though the Malathion-oil sprays were not as effective as 1.3 percent oil, infestations were reduced to a low level and treatments could be classed as commercial control.

Initial results in the March experiment, Table 1, were inconsistent. Three months after the applications, however, relative infestations were all lower with the Malathion-oil sprays than with the standard 1.3 percent oil.

In a third experiment, medium to heavy infestations of purple scale and Florida red scale, **Chrysomphalus aonidum** (L.), were present. A 25 percent wettable Malathion was mixed with .5 percent oil and with wettable sulfur. Parathion was used as a standard for comparison (Table 2). Malathion at 2 or 3 pounds plus oil was not as effective as 1.7 pounds of 15 percent parathion per 100 gallons for purple scale control, but was more effective than 5 pounds of Malathion mixed with wettable sulfur. For red scale control, the Malathion-wettable sulfur mixture was as effective as the mixture of Malathion and oil. However, scale infestations were reduced to a low level with all Malathion mixtures.

In one experiment a 57 percent emulsifiable Malathion containing 5 pounds of the active ingredient per gallon and a 44 percent emulsifiable Chlorothion containing 4 pounds per gallon used with .7 percent oil and with 5 pounds of wettable sulfur per 100 gallons. Malathion and Chlorothion were applied at dosages of 1, ½, and 2 pints per 100 gallons. Parathion at 1 pound plus

(Continued on page 28)

**Table 1**
**Purple Scale Control with Oil-Malathion Mixtures**

| Materials as active ingredients per 100 gallons | Corrected Relative Infestations after spray | | | |
|---|---|---|---|---|
| | Sprayed Nov. 9 | Sept. 21 Jan. 26 | Sprayed March 6 April 1 | June 1 |
| Oil emul. 1.3% oil (standard) | 100[1] | 100 | 100[2] | 100 |
| Oil emul. .65% | 99 | 338 | 270 | 130 |
| Oil emul. .65%, Malathion[3] .25 lb. | 26 | 260 | 44 | 70 |
| Oil emul. .65%, Malathion .50 lb. | 26 | 171 | 344 | 70 |
| Oil emul. .65%, Malathion .75 lb. | 62 | 171 | 130 | 52 |
| Wettable sulfur 8 lbs. (check.) | 4885 | 3200 | 2911 | 947 |

[1] 1.35 third stage females per leaf before spray; after spray, Nov. 9, .01, Jan. 26 .08.
[2] 1.18 third stage females per leaf before spray; after spray, April 1, .01, June 1, .17
[3] 25 per cent wettable.

**Table 2**
**Purple and Red Scale Control with Oil-Malathion Mixtures.**

| Materials as Active Ingredients per 100 Gallons Sprayed August 3, 1956 | Corrected Relative Scale Infestations, September 17 | |
|---|---|---|
| | Purple | Red |
| Sulfur, 10 lbs., parathion (standard) .25 lb. | 100[1] | 100[2] |
| Oil emul., 5%, Malathion[3] .50 lb. | 310 | 215 |
| Oil emul., 5%, Malathion .75 lb. | 291 | 406 |
| Sulfur, 10 lbs., Malathion 1.25 lb. | 512 | 365 |

[1] 1.87 third stage female purple scale before spray; after spray .01.
[2] .73 third stage female red scale before spray; after spray .01.
[3] Applied as a 25% wettable powder.

**Table 3**
**Control of Purple and Red Scale with Varying amounts of Malathion and Chlorothion.**

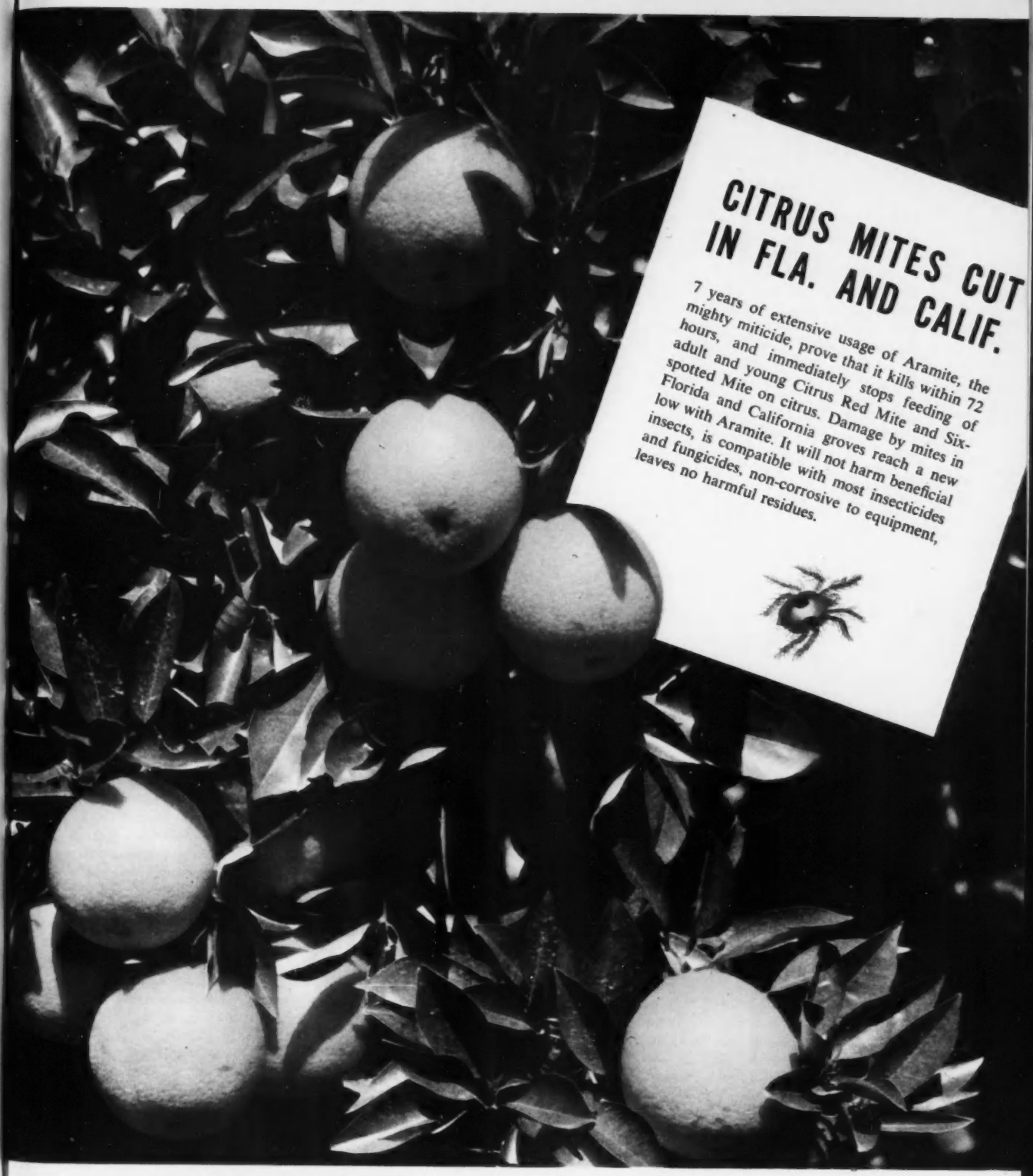
| Materials as Active Ingredients per 100 Gallons Spray May 16. | Corrected Relative Infestations | | | |
|---|---|---|---|---|
| | Purple Scale July 30 | Sept. 24 | Red Scale July 30 | Sept. 24 |
| Oil emul. 1.3% oil (standard) | 100[1] | 100 | 100[2] | 100 |
| Oil emul. .7% Malathion[3] .62 lb. | 45 | 124 | 19 | 43 |
| Sulfur 5 lbs., Malathion .62 lb. | 103 | 533 | 347 | 275 |
| Oil emul. 7%, Malathion .93 lb. | 22 | 115 | 62 | 60 |
| Sulfur 5 lbs., Malathion .93 lb. | 52 | 239 | 34 | 10 |
| Oil emul. .7%, Malathion 1.24 lbs. | 50 | 37 | 59 | 25 |
| Sulfur 5 lbs., Malathion 1.24 lbs. | 31 | 123 | 64 | 105 |
| Oil emul. 7%, Chlorothion[4] .50 lb. | 24 | 77 | 53 | 12 |
| Oil emul. .7%, Chlorothion .75 lb. | 15 | 50 | 67 | 25 |
| Sulfur 5 lbs., Chlorothion .75 lb | 267 | 447 | 298 | 190 |
| Oil emul. .7%, Chlorothion 1.00 lbs. | 16 | 56 | 13 | 7 |
| Oil emul. .7%, parathion .15 lb. | 89 | 24 | 33 | 3 |
| Sulfur 5 lbs. | —— | —— | 2179 | 404 |
| | | | 1124 | 838 |

[1] 1.57 third stage female purple scale per leaf before spray; after spray, July 20, .42; Sept. 24, .53.
[2] .11 third stage female red scale per leaf before spray; after spray, July 20, .17; Sept. 24, .85.
[3] 57% emulsifiable.
[4] 40% emulsifiable.

**Table 4**
**Purple Scale Control with Different Malathion Formulations.**

| Materials Active Ingredients per 100 Gallons Sprayed May 2, 1957 | Corrected Relative Infestations | |
|---|---|---|
| | June 23 | August 8 |
| Oil emul. 1.3% oil (standard) | 100[1] | 100 |
| Oil emul. .7% | 307 | 394 |
| —— —— Malathion 57% e.l. .62 lb. | 231 | 427 |
| Oil emul. .7%, Malathion 57% e.l. .62 lb. | 183 | 146 |
| Oil emul. .7%, Malathion 87% e.l. .50 lb. | 119 | 313 |
| Oil emul. .7%, Malathion 25% w.p. .50 lb. | 243 | 278 |
| Oil emul. .7%, Malathion 57% e.l. .78 lb. | 169 | 291 |
| Oil emul. .7%, Malathion 87% e.l. .75 lb. | 49 | 142 |
| Oil emul. .7%, Malathion 25% w.p. .75 lb. | 36 | 143 |
| No Scalicide | 632 | 737 |

[1] 1.06 third stage female per leaf before spray; after spray, June 23, .27; August 8, .20.

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# Citrus Canker In Brazil

DR. A. F. CAMP
VICE-DIRECTOR EMERITUS
CITRUS EXPERIMENT STATION
LAKE ALFRED, FLORIDA

On arriving in Brazil in June of 1957 I was informed that citrus canker, known to pathologists as cancrosis, had been found during the previous April. The location of the first infection found was in the western tip of the state of Sao Paulo in plantings close to the city of Presidente Prudente.

A conference with Dr. Agesilau Bitancourt of the Institute Biologico in Sao Paulo revealed that the causal organism had been identified as Cancrosis "A", the type we had years ago in Florida, and not Cancrosis "B", another strain, which attacks lemons severely in Argentina but does little damage to oranges and grapefruit.

He also informed me that the area involved had a large population of Japanese and it was very possible that the disease had been brought from Japan on plant material which had escaped detection by the Plant Quarantine Inspectors. This was a natural conclusion since live canker had previously been intercepted in baggage at the Port of Santos and it would be reasonable to suppose that this outbreak involved a case that had avoided detection. Unfortunately I was unable to go to the infected area at that time, being due in Argentina.

On my return to Brazil the following September I was able to make a trip to the infected area which is about 2½ hours by plane from the city of Sao Paulo. I was accompanied by Mr. Nicolau Nadai, of Citrobrasil, and Ing. Vasconcelos, also of the same organization.

The trip was made on Sept. 16th to 19th, which, because their seasons are the reverse of ours, tree condition corresponded to that of mid-March in Florida. We were very kindly received by the Inspector from the Instituto Biologico who was in charge, and shown around and also supplied with considerable information. Later at the Instituto Biologico in Sao Paulo we were able to obtain preserved specimens.

The area involved is very thinly populated though the city of Presidente Prudente has a population of more than 25,000 with a considerable percentage of these being Japanese immigrants or their descendants. Located around the town are a number of small plantings and one sizeable grove, the latter as yet uninfected.

Once away from the immediate environs of the city, houses are very scattered and roads usually passable only to Jeeps and sometimes only by horse cart or horseback. The area is not a commercial citrus area, being devoted principally to cotton, cattle and coffee.

However, on renting a plane and flying over the area we found that practically every homestead had citrus trees for household fruit and in many cases there were only trails to such locations. We were informed, however, that canker had been found frequently in such isolated properties probably brought in on nursery plants, fruit or on the hands or clothing of people.

The area is connected with the city of Sao Paulo by a main highway, a small part of which is paved and the remainder scheduled for paving. This road passes through the Sorocaba citrus area before arriving at Sao Paulo. Since there is no commercial citrus of note immediately around Sao Paulo only the Sorocaba area would be highly vulnerable if this were the only main highway out of the area.

Unfortunately there are also cross highways to the main citrus belt and although these are not paved there is considerable truck traffic. Up to now funds have not been available for establishing active quarantine stations on the numerous roads out of the area and dependence must be placed on the road police to intercept shipments of nursery stock and fruit.

Figure 1 shows a map of the state of Sao Paulo with the location of the principal cities shown, along with the presently known infected area and the main citrus producing area. Distances to Sao Paulo and also Araraquara in the center of the commercial citrus zone are shown. The main movement of fruit is to Sao Paulo and Santos, but cross traffic is considerable between the area around Presidente Prudente and the citrus belt even though the roads are only improved clay roads. A paved road runs from Santos through Sao Paulo to Campinas and Limeira.

### Many Trees Destroyed

The area involved includes, besides the county of Presidente Prudente, more than a dozen other counties making an irregular block about 90 miles by 60 miles. The disease was originally found in April, 1957, in a nursery near the city of Presidente Prudente. Subsequent study indicates that this area around Presidente Prudente, which is estimated to contain about 30,000 bearing trees, was probably the center of the infection and the spread from there due principally to the movement of infected nursery stock.

In this area they had found, up to Aug. 26th, eight infected nurseries and had destroyed 157,695 nursery trees. A total of 817 grove or household plantings had been inspected and 282 found infected, and in these, 14,358 bearing trees had already been destroyed in 128 properties. Outside of the county of Presidente Prudente 561 non-nursery properties had been inspected and only 46 found infected. In this area 17,215 nursery trees in 3 nurseries and 2,574 bearing trees in 10 properties had been destroyed.

It is calculated that in the infected area outside of the county of Presidente Prudente there are about 120,000 bearing trees, making a total of 150,000 in the known infected area. Of these probably less than half are in groves which usually have less than 400 trees, while the remainder are in household plantings.

The extremely scattered distribution plus the lack of readily passable roads make both inspection and

destruction difficult and costly. As we have found in the past in Florida, the one to ten tree holdings offer more difficulty than large properties and the same appeared to hold true in this area. In addition to the area in Sao Paulo the disease has been located in the adjoining state of Parana and probably also in Mato Grosso, and in both cases infected nursery stock was probably the source of the infection.

**Appropriation For Control**

The Instituto Biologico, which has charge of such matters in the state of Sao Paulo, is working intensively on an eradication program but up to now with very little money and equipment. Recently 20,000,000 cruzeiros of federal money were authorized for the work as a result of requests by the Instituto Biologico and the commercial growers in the main citrus area. As soon as this is available the situation should be eased and the work proceed more rapidly. The plan is for an eradication program based on that carried out between 1913 and 1929 in Florida, rather than a control or containment program.

One of the big questions involved in the campaign is whether to pay the growers for trees destroyed. People with dooryard trees usually are not inclined to feel much moral responsibility for growers in a commercial area two hundred miles away and want pay for trees destroyed. Japanese in the area also point out that in Japan the disease does little damage, a fact resulting from the resistance to the disease of the Unshiu Mandarin (Satsuma) which is the chief Japanese production, plus the very cool climate which is not particularly favorable to the casual organism.

They have no knowledge of the extreme damage caused in Florida, which has a similar climate to the Brazilian area or similar damage in the Phillipines. Since there are large numbers of Japanese in the area, the problem is thus complicated, particularly since the Japanese vote in the state of Sao Paulo is large and their political influence to be reckoned with.

The Instituto Biologico is hoping for permission to pay for the trees which might make it possible to destroy trees around isolated homes whether they are diseased at the moment or not, and thus greatly reduce the need for costly inspections. If 50 or 60 thousand trees could be eliminated by purchase, the problem would be much simpler. Support for this is coming from the citrus industry in the commercial area.

**Technicalities**

From a technical aspect there are some interesting angles. The disease is attacking grapefruit, of which there are only a few trees in the area, sweet orange, Ponkan, mandarines, Rangpur limes, Key limes and lemons. Just before my trip to the area they also found sour orange heavily attacked. This caused Miss Rosetti, who is in charge of identification work in the absence of Dr. Bitancourt, to fear that they also had Concrosis "B", sometimes known as "false canker."

This disease is found in Paraguay, Uruguay and Argentina. It was described by Bitancourt and Fawcett as attacking principally West Indian limes and occasionally lemons and sour orange. Cancrosis "A" based on work in Florida and the Phillipines was worse on grapefruit while lemons were much less severally attacked. It is entirely possible that there may be several strains of the canker organism or that the severity of attack on various varieties may depend on growing conditions. Cancrosis "B" as known in Argentina is

(Continued on page 21)

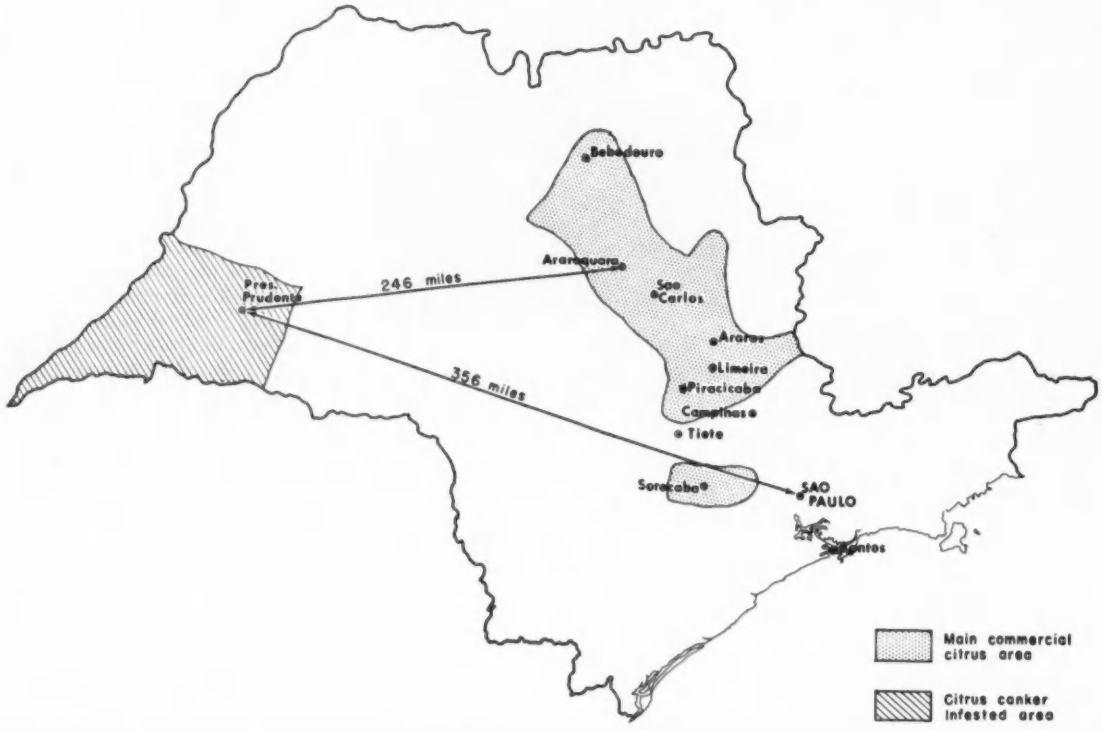


Fig. 1. Outline map of the state of Sao Paulo, Brazil, showing citrus canker infected area in relation to the main citrus belt.

# Freezing Points Of Fruits

**SUMMARY**

Freezing points were determined for the principal fruits, vegetables, and florists stocks. The data can provide a guide that growers, shippers, storage operators, and others concerned with the marketing of these commodities can use to minimize or avoid freezing damage and losses.

The freezing points of some living products may approach 32° F., the freezing point of water, but they never reach this point. In the tests reported, the freezing points of most fruits ranged from 27° to 30° and of most vegetables from 29° to 31°. Freezing points of florist stocks varied widely, depending to a great extent on the part of the plant tested.

This report is concerned only with the temperatures at which various products may freeze. It should be emphasized that many commodities may be injured by temperatures considerably above their freezing points, a few even when stored at a temperature as high as 55° F.

. . . By . . .
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### Introduction

The temperatures at which perishable commodities may be injured by freezing in the field, in storage, or during transit and marketing are of practical concern to the many who grow and handle fruits, vegetables, and florist stocks.

Killing frosts or freezes during the growing or harvesting season cause extreme concern to the growers of many horticultural crops. Fruits, vegetables, and flower crops are occasionally frozen in the field and rendered unfit for shipment. At times they may also be damaged by freezing en route to their destinations. It is therefore evident that knowledge of the temperatures at which the various products are likely to freeze is important to growers, shippers, carriers, and receivers. Since certain products are stored either before shipment or at destination, storage warehousemen too must be alert in their control of storage rooms, especially those held at about 32° F., to see that temperatures do not accidentally fall below the freezing point of the commodity stored. Knowledge of the freezing point of a product provides a definite guide in determining whether inspections for freezing damage are necessary.

However, the freezing point of a commodity is not necessarily an indication of the damage that might be expected from low temperatures, as certain horticultural crops are susceptible to cold injury by temperatures that are not low enough to freeze them, while a few may be frozen and thawed a number of times without injury.[2]

There is always the possibility that a product may freeze during the marketing period after its arrival at destination or removal from storage. Freezing of product should be constantly guarded against at the terminal markets, at both wholesale and retail levels. Here again, operating personnel in these establishments who know the freezing points can use them as danger points near which damage may occur.

Requests for information have indicated considerable interest in freezing points. About 600 freezing points are reported here, including those for 37 kinds and varieties of citrus fruits, 19 apple varieties, 11 varieties of pears, 11 kinds or varieties of grapes, 15 varieties of avocados, 11 varieties of potatoes, the roots of 10 sweetpotato varieties, and many other kinds and varieties of fruits, vegetables, and florist stocks. In many instances, freezing points were determined for a commodity and for different parts of that commodity, such as peel and flesh of bananas, tops and roots of beets, flesh and rind of citrus fruits, and strawberries and crowns and roots of strawberry plants as customarily stored. Standard commercial varieties as well as some newer ones were selected for these studies.

### Equipment and Methods

Freezing points were determined with a 20-point electronic recording potentiometer using 24-gage wire for the standard, twisted-wire, copper-constantan thermocouples (figs. 1 and 2). With this equipment, the temperature changes before, during, and after freezing for either 10 or 19 specimens or composite samples of 1 kind or variety were obtained simultaneously. The freezing point of each of these specimens or unit samples was determined separately, and from these findings the average, lowest, and highest freezing points are given in tables 1, 2, 3, and 4. In most cases, the products were frozen in a room held at 21° to 22° F.

During this freezing-point work, the potentiometer was set to register every 30 seconds, recording the temperature of each of the 20 individual thermocouples every 10 minutes. The rated accuracy of the instrument was + or − 0.3° F. One thermocouple was used as a constant check on the accuracy of the instrument. It was put in a small glass tube (containing about 3 inches of mercury) which along with a thermometer, was placed in a thermos bottle filled with a distilled-water ice and distilled-water mixture giving a temperature of 32°, the mixture being renewed daily. The instrument was adjusted, whenever required, so that the reference thermocouple maintained 32°, + or − 0.1°. Periodically, the thermocouples were calibrated in mercury at 32° and the instrument was checked against a precision potentiometer.

The percentages of soluble solids of the juice of a number of products were determined with laboratory and hand refractometers. The pH values were determined by the glass electrode method. Whenever the relation between soluble solids and freezing points is discussed, the average freezing points are used, since the juice used to determine soluble solids was a composite sample.

The temperature of a product may be lowered below its freezing point without freezing taking place; that is, without the formation of ice crystals. This is known as supercooling. When a commodity is supercooled, any sudden jarring may cause it to freeze. In commercial storage, if this occurs accidentally it is desirable to raise the room temperature and avoid disturbing the commodity. Doors should be closed gently and floors should not be jarred by the rolling about of heavy objects. These pre-

cautions minimize freezing damage, because the individual specimens that have been supercooled may warm up without ice being formed in their tissues.

In determining freezing points, supercooling may or may not occur. As freezing begins, latent heat is released, and usually the temperature rises rapidly, sometimes to a peak temperature slightly above the freezing point. The rise in temperature is then followed by a plateau or "leveling off" period of varying length during which the temperature of the tissue surrounding the thermocouple is constant. Usually the first constant temperature is taken to be the freezing point of the product.

Satisfactory freezing points were obtained with specimens of 2¼ inches and over in diameter without special preparations. Individual specimens as small as limes or plums were wrapped in several thicknesses of aluminum foil. Items such as cranberries or grapes were cut or chopped and placed in handmade aluminum foil balls 2¼ inches in diameter and squeezed to eliminate air spaces. Leaves of low moisture content and fluffy products such as acacia flowers were made into aluminum foil bundles at least 2¼ inches in diameter and wrapped very tightly with twine in order to exclude as much air as possible. Thermocouples were always inserted to a depth of not less than one-half inch to avoid having them too close to the cold room air.

## RESULTS

### Highest Freezing Point a Guide To Freezing Injury

In certain species, such as oranges, the freezing points of different varieties vary to such an extent that an average freezing point for the species would be of questionable value. The mean freezing point of the flesh of all varieties and lots of oranges tested was 28.5° F. within extremes of 26.7° and 30.3° (table 1). It is obvious that each variety should be considered seperately because 28.5° (+ or − 1.8°) as an average freezing point for oranges would be of little worth.

The range in "highest" freezing points obtained for the varieties of each species is given for most of the important fruits and vegetables. For example, the flesh of Lue Gim Gong oranges had freezing points as follows: Average 26.7° F., lowest 25.9°, and highest 27.4°. Freezing points of the flesh of Hamlin oranges were: Average 29.4°, lowest 28.2°, and highest 30.6°. Hence, the range in highest freezing points for the 14 varieties of oranges was 27.4° to 30.6°. Some freezing damage may occur with this range for the orange varieties tested, but the likelihood of injury to any one variety is more accurately based on the highest freezing point obtained for that variety.

### FREEZING POINTS OF FRUIT

One or more samples of the following fruits had highest freezing points between 27.0° and 27.9° F.: Cherry (sweet), grape, orange (rind), and pear. Fruits with freezing points between 28.0° and 28.9° were apple, banana (flesh, ripe), coconut (flesh), grapefruit (rind), lime, orange (flesh), orange (rind) and pear. Freezing points of the following fruits ranged from 29.0° to 29.9°: Apricot, banana (flesh, ripe), blueberry, cherry (sour), cranberry, grapefruit (flesh), lemon, mango, nectarine, orange (flesh), pear, plum and tangelo. Fruits with freezing points ranging from 30.0° to 30.9° were avocado, banana (flesh, green), blackberry, cranberry, gooseberry, nectarine, papaya, peach, pineapple, raspberry, strawberry and tangerine.

### AVOCADO

The range in highest freezing points of 15 varieties of avocados was 29.1° to 31.5° F. The degree of ripeness of the avocados influenced the freezing points considerably. The highest freezing points of the hard-ripe, eating-ripe, and soft-ripe fruits of the Booth 7 variety were 30.0°, 30.4°, and 31.5°, respectively.

### GRAPEFRUIT

The ranges in highest freezing points of 5 important varieties of Florida grapefruit were 28.9° to 30.0° F. for the flesh and 26.9° to 29.7° for the rind. The highest freezing points of the flesh were 0.3° to 2.0° higher than those of the corresponding rind in 8 out of 9 instances. The soluble solids of the rind were higher than those of the flesh.

### MANGO

The highest freezing points of 5 varieties of mangos ranged from 29.4° to 30.3° F. The hard-ripe fruits were somewhat higher in freezing points, lower in pH values, and lower in soluble solids than ripe fruits.

### NECTARINE

The highest freezing points of the Quetta variety of nectarine were 30.1° F. in hard-ripe fruits and 29.3° in firm-ripe fruits. The average freezing points were 29.8° in hard-ripe fruits and 28.8° in firm-ripe fruits. Soluble solids of hard-ripe and ripe fruits were 9.3 and 13.1 per cent, respectively. The highest freezing point recorded for the John River variety was 30.4°.

### ORANGE

The highest freezing points of the flesh of 14 varieties of oranges ranged from 27.4° to 30.6° F. The freezing points of the flesh were higher than those of the rind in practically all instances. The soluble solids of the rind of Jaffa (lot 1) and Washington Navel oranges (lot 1) were 4.0 and 3.7 percentage points greater, respectively, than those of the flesh. The soluble solids of the rind of Honey Murcott oranges were 8.8 percentage points higher than those of the flesh.

The highest freezing point of leaves of Florida Valencia orange trees was 28.7° F.

### STRAWBERRY

The range in highest freezing points of 19 varieties of strawberries was 29.8° to 30.6° F. Soluble solids ranged from 6.1 to 10.1 percent in the ripe fruits of these varieties. The average freezing points were only slightly lower than the highest freezing points. There was no relation between average freezing points and soluble solids. The Fairfax variety had the lowest average freezing point and next to the highest soluble solids.

Freezing points, soluble solids,

and pH values were determined for green and ripe berries of Blackmore, Midland, and Pocahontas varieties. Soluble solids were higher in the ripe fruits than in the green fruits, but the average freezing points of the ripe berries were lower than those of the green ones only in the Midland variety.

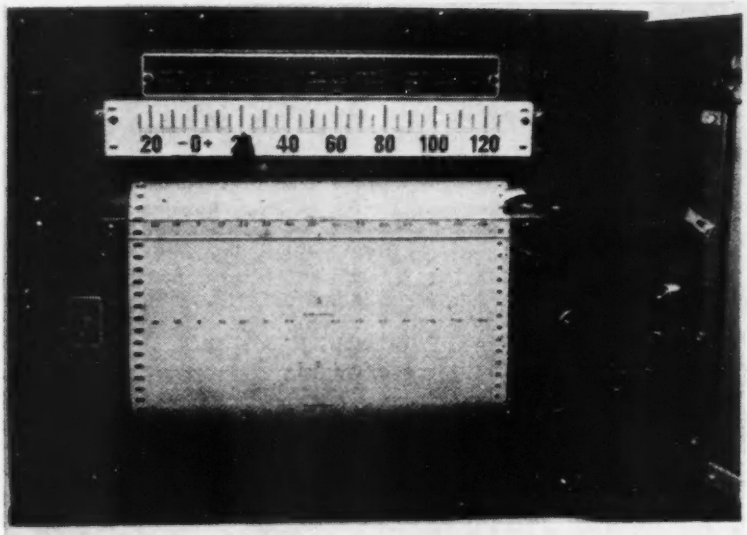



FIGURE 1.—*Recording potentiometer used in freezing-point determinations.*

### TANGELO

The highest freezing points of the flesh of 4 varieties of tangelos ranged from 28.0° to 30.3° F., and those of the rind from 26.4° to 29.0°. The average freezing points of the flesh of these varieties were higher than those of the rind. Soluble solids and pH values of the flesh were lower than those of the rind.

### FREEZING POINTS OF VEGETABLES

Freezing points were determined for about 50 kinds of vegetables for about 50 kinds of vegetables.

One or more samples of the following vegetables had highest freezing points between 29.0 and 29.9° F.: Artichoke (globe), beets, broccoli (buds), carrots, garlic (dry bulbs), horseradish roots, leek (stalk), muskmelon (2 kinds), okra, peas (garden), shallot (dry bulbs), squash (1 variety), and sweet potatoes (cured). Vegetables with highest freezing points between 31.0° and 31.9° were: Bean (lima, shelled), beet tops, broccoli rabi cabbage, celery, cress (water), cucumber, dandelion greens, endive (curled and broadleaved), kale, lettuce, mustard greens, radish and rhubarb leaves, shallot (Louisiana, tops and leaf base), spinach, squash (summer scallops and zucchini, both immature), tomato fruits, turnip greens, and watermelon rinds (2 varieties). The highest freezing points of all other vegetables, except certain lots of potatoes, were between 30.0° and 30.9°.

The range in highest freezing points of potatoes held at 55° F. for 60 days or less ranged from 30.2° to 30.5°.

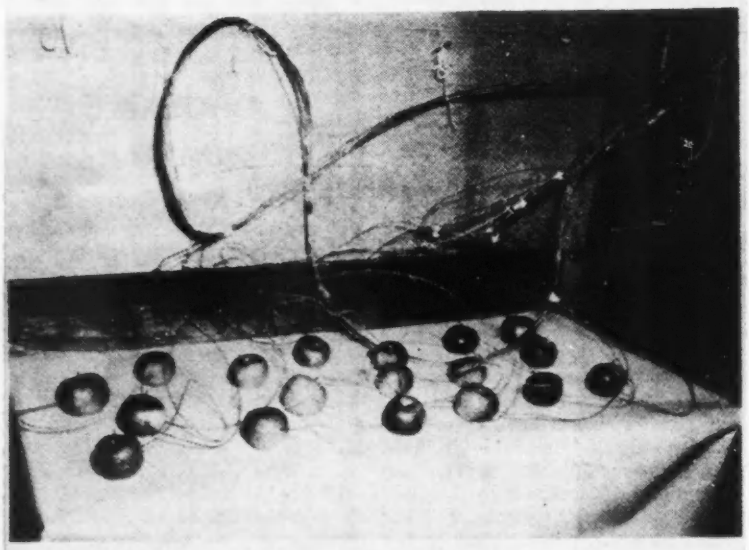
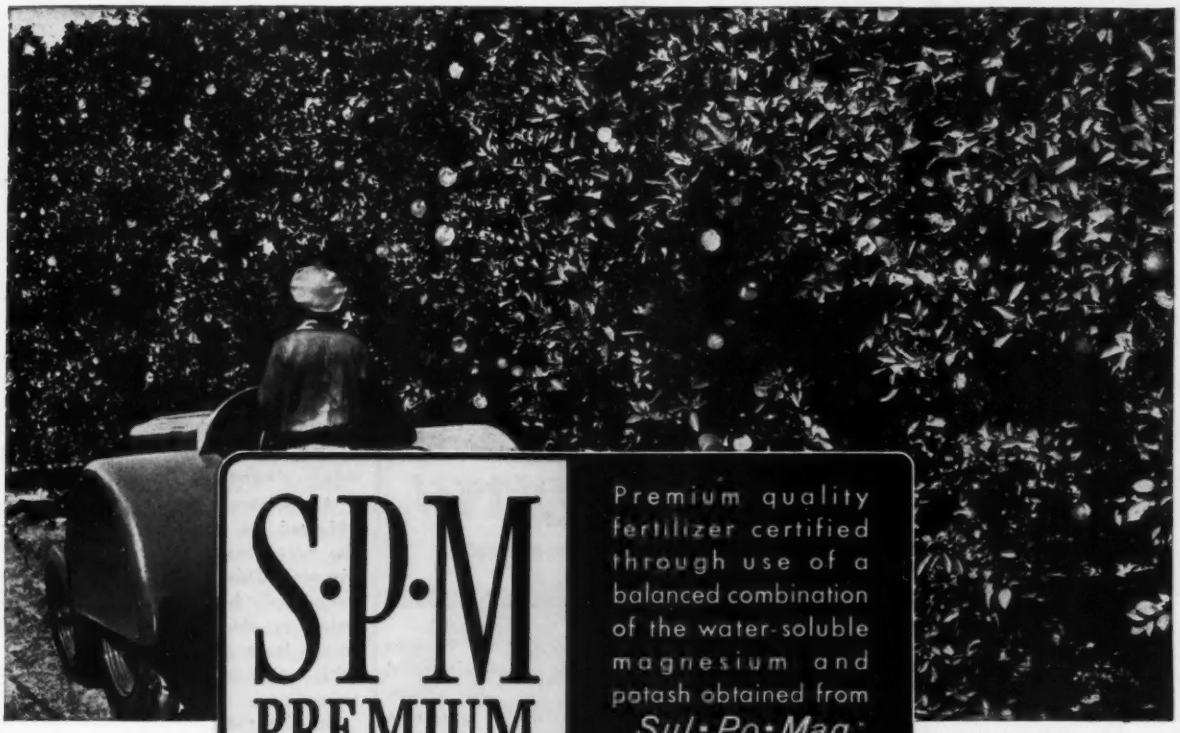


FIGURE 2.—*Method of determining freezing points with thermocouples, showing these inserted to a depth of one-half inch in apples.*

A recent USDA research survey estimates that for every dollar a livestock owner spends for veterinary services, he gets a return of $5.78 on his investment.

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# Occurrence Of Mixtures Of Tristeza Virus Strains In Citrus . . .


## SUMMARY

Tristeza virus from selected sources caused very mild, mild, or severe symptoms of stunting, vein and veinlet clearing in the leaves, and piting of the stems beneath the bark of Key lime test plans. Branch growth of the inoculated Key lime plants was proportional to the severity of symptoms induced by the tristeza virus employed. Repeated selections and transmissions by leaf pieces from mildly affected sources have indicated that mild tristeza virus in Florida is a virus that mutates readily or that exists as a mixture of strains, some of which consistently cause stem pitting and others few or no stem pits on Key lime plants. Cross-protection tests with selected virus sources resulted in varying degrees of protective effects. The explanation for the presence of virus strain mixtures within a given plant appears to be related to the failure of any 1 strain to become thoroughly systemic, thus affording susceptible sites for the development of other strains.



THEODORE J. GRANT

And

RICHARD P. HIGGINS


The existence of strains of tristeza virus, some of which cause mild symptoms and others severe symptoms, was demonstrated in Brazil (8). The maintenance there for a 3-year period of sweet orange trees with either mild or severe symptoms on non-tolerant rootstocks and on key lime seedlings, together with the lack of symptom expression with either type of virus strain in sweet orange on a tolerant rootstock, constituted further evidence of the existence of tristeza virus strains (5). Both strains of tristeza virus were obtained through transmission by means of the aphid vector, Aphis citricidus (Kirk.). The freedom of the test plants from the viruses causing psorsis, xyloporosis, and exocortis was indicated by the fact that symptoms incited by these other viruses were not observed in the rootstock tests (9) on plants inoculated by means of aphids. Field observations and tests in Africa (12, 13) and more recently in Texas (17) also present evidence of the existence of tristeza virus strains.

Since the first report from Florida (11) of a strain of tristeza virus that induces relatively mild symptoms on Key lime test plants, its widespread distribution has been demonstrated (2). The present studies demonstrate the existence of mixtures of tristeza virus strains.

METHODS.—Aphid transmission of tristeza virus from scattered grove trees to Key lime plants (15) provided sources of tristeza virus believed to be free of viruses that are not aphid transmitted.

A Key lime plant that became infected after it had been placed close to an aphid-infested Temple orange tree known to be carrying the tristeza virus is referred to as the $T_0$ source of very mild tristeza virus. Repeated tissue transmissions to Key lime plants from this source consistently resulted in very limited vein-clearing symptoms and very few scattered pits on the stems beneath the bark.

Two Key lime plants infected with tristeza virus as a result of controlled aphid-transmission tests (16) in which the Temple orange field tree mentioned previously was used as source of inoculum were selected as sources of mild tristeza virus, because of their scattered vein-clearing and stem-pitting symptoms. They are herein referred to as $T_1$ and $T_2$ sources of mild tristeza virus.

The $T_2$ source was obtained by tissue and not by aphid transmission from a lime tree in the field, thus it could have been carrying other viruses. The inoculated Key lime test plants, however, showed distinct vein and veinlet clearing with a tendency toward flecking, yellowing, and cupping of the leaves; stunting of growth; and the production of many pits or striations in the stem beneath the bark of the infected plants. These symptoms are typical of a severe tristeza virus reaction on Key lime, but they are not considered to be as severe as those caused by the common or severe tristeza virus strain studied in Brazil.

All tristeza virus sources herein referred to are being tested for the presence of other known cirtus viruses. This work has not been completed, but each source is labeled so that it may be referred to in later publication if mixtures with other citrus viruses are involved.

In the comparative tests reported, efforts were made to use comparable Key lime seedling test plants. In general, the inoculations were made with leaf pieces (19), and the top edge of the leaf was left outside the bark flap so that its continued living condition would indicate successful union and potential virus transmission. At the time of inoculation, plants in any given test were cut back to a single main stem and to approximately the same height. Growth measurements of length in cm included only the new branch growth from these main stems. The counts of stem pits were made on comparable representative branches from the upper, middle, or lower portion of the inoculated plants or on all the branches on each plant. Because of differences in plant growth and length of branches, it was necessary to obtain the average number of stem pits for a standard unit. The term stem pit refers to this characteristic symptom of tristeza in Key lime stems from which the bark has been removed.

RESULTS—Comparison of stem growth of inoculated Key lime plants.—Measurements of the average number and total growth of branches on the noninoculated healthy control and inoculated Key lime plants 4, 6, and 9 months from the date of inoculation from the different virus sources are shown in Table 1. The greatest

difference between the inoculated and noninoculated plants occurred in the average total stem growth. It is evident that the effect on growth was more or less proportional to the severity of leaf and stem-pitting symptoms described for the sources employed.

Stem pitting on inoculated test plants.—Observations on the occurance and abundance of stem pits on Key lime test plants indicated that there were a number of interrelated factors affecting the expression of this symptom. When tristeza-affected field trees were used as sources of virus, some produced more stem pits on the test plants than did others. Repeated collections from a single source tree could also result in some differences in the number of pits on the inoculated plants. A study of the number of pits on each branch of the test plants showed that variations occurred. Plants inoculated with the mild tristeza virus might show an initial shock effect, which was followed by milder symptoms in subsequent growth. The branch first infected was frequently suppressed in growth. Such a branch sometimes showed appreciable pitting, whereas new branch growth had very few pits. There sometimes were cycles of leaf symptoms and stem pitting. In general, growth mode in the greenhouse during hot summer weather showed few vein-cleared leaves and less stem pitting than did growth made under conditions of cooler weather and shorter day length of the winter and early spring. For example, comparable branches from Key lime plants inoculated by means of leaf tissue from the mildly affected sources $T_1$ and $T_2$ produced an average of 0.5 and 0.4 pit, respectively, per 10 cm of stem in October, whereas comparable readings from the same plants in December averaged 8.5 and 2.7, respectively. In December, the Key lime plants inoculated with the $T_3$ severe tristeza virus showed an average of 67 pits per 10cm of stem, and those inoculated with the $T_0$ very mild tristeza virus had only 0.08 pit. Although variations in the dates of inoculations and size of the plants might account for some variations in stem pitting, the virulence of the virus strain, as indicated by leaf symptoms and growth of the source plants, appeared to be the most important factor controlling the comparative intensiy of stem pitting. Study of the data also suggested that variations in the amount of stem pitting on plants inoculated by tissues from the source plants $T_1$ and $T_2$ might be due to mixtures of tristeza virus strains in these plants even though they had been inoculated by aphid populations that had acquired the virus from the same field tree.

A test was undertaken to determine whether a strain producing many stem pits and one producing no pits could be obtained from these sources. Leaf tissue transfers had been made from the $T_1$ and $T_3$ sources to Kalpi lime (Webber's Philippine hybrid) plants and notable differences observed; some plants showed only vein clearing, whereas others had an initial shock reaction and the young terminal growth was yellow.

Progressive selections and leaf-tissue transfers from Kalpi lime plants with marked leaf and stem-pitting symptoms resulted in the obtaining of a strain or strains that caused almost 8 times as many pits in Kalpi lime test plants as did the original inoculum (Table 2). In contrast, selections and transfers from Kalpi lime plants with few to no symptoms resulted in the obtaining of a strain or strains

that produced almost no pits on Kalpi line test plants (Table 2). At the same time, leaf tissue from these same selections from source plants with few pits, when transferred to Key lime plants, resulted in appreciably more pits than did the original. These results may be related to the method of selecting leaf pieces used as inoculum. Leaf-piece selections for increasing stem pits were relatively specific in that they were from the plants and the portion of the leaf showing the most distinct symptoms. In contrast, selections for reduction of pitting were from plants having very few symptoms and by random selection of a leaf from any one of a large number that showed no symptoms. Whether the virus or virus strains were equally distributed in all portions of these symptomless leaf pieces was unknown.

TABLE 1.—Branching and stem growth of Key lime plants following leaf-piece inoculation with tristeza virus from different sources.

| Source of inoculum | Interval (months)a | Average no./b branches: Main stem | Average no./b branches: Rebranches | Total length branch growth: Average/b (cm) | Total length branch growth: Percentage of check |
|---|---|---|---|---|---|
| None (Check) | 4 | 7.9 | 1.5 | 104 | |
| | 6 | 9.0 | 4.6 | 240 | |
| | 9 | 8.6 | 11.3 | 470 | 100 |
| $T_0$ (Very mild) | 4 | 6.2 | 1.4 | 93 | |
| | 6 | 6.2 | 15.8 | 239 | |
| | 9 | 5.8 | 25.8 | 459 | 98 |
| $T_1$ (Mild) | 4 | 7.6 | 2.2 | 62 | |
| | 6 | 7.8 | 9.8 | 156 | |
| | 9 | 7.6 | 13.8 | 331 | 70 |
| $T_2$ (Severe) | 4 | 7.4 | 2.8 | 36 | |
| | 6 | 8.6 | 9.2 | 62 | |
| | 9 | 7.6 | 14.2 | 123 | 26 |

a/ Interval between inoculation and taking of data.
b/ Figures are averages for 5 potted plants in greenhouse.

It can be noted (Table 2) that the second selection for increasing stem pits was a plant that had about 9 to 40 times more pits than did the other 3 plants in this series. Observations of the leaves of this second selection source plant indicated that it might be considered slightly off type. In fact, it was at first thought that the great increase in number of pits might be related to a specific sensitivity and symptom expression on this particular plant rather than any relation to a change in the virus strain. Leaf tissue transmissions from this plant to test plants, however, maintained the same high level of pitting in Kalpi limes and increased the number of pits on Key limes to approximately 3 times more than did inoculations from the first selection (Table 2). These results suggest that dominance of the strain or strains resulting in stem pitting may be influenced by psysiological differences in the inoculated plants, but once established, the high level of stem pitting can be reproduced in test plants by leaf-tissue transfers.

The results also suggested the need to determine whether strains might be sorted out from a single source plant. Leaf pieces from the $T_0$ very mild source were used to inoculate 25 Key lime plants. From this group, the plant showing the most pronounced leaf symptoms and the one showing the mildest leaf symptoms were selected as sources of inoculum for further transmission tests. In like manner, 25 Key lime plants were inoculated from the $T_1$ source, and from this group the plant showing the mildest symptoms was selected. A strong pitting strain from the $T_1$ source had already been selected, and the Key lime plant with 71 pits per 10 cm of stem was used. Leaf pieces from each of these sources were used to inoculate series of 5 Key lime plants. The range in the average number of pits per 10 cm of stem on the inoculated Key lime plants in each series follows. When the source was $T_0$, the first selections for reduction of pits gave 0.0-0.8 pit, and the first sections for increase gave 0.3-4.7 pits. When the source was $T_1$, first selections for reductions of pits resulted in 3-9 pits, and the third selection for increase produced 61-174. Counting of large numbers of pits was difficult because of their merging into striations. The values presented represent the best estimate. Growth of individual plants in a series was variable, but the data obtained showed that branch growth of the Key limes inoculated from the first and second selections from the $T_0$ source averaged 85 and 95 per cent, respectively, and growth of plants inoculated from the first and third selections from source $T_1$ averaged 71 and 51 per cent, respectively, of that attained by the noninoculated controls.

The data from these tests indicate that the mild tristeza virus, as represented by the $T_1$ and $T_2$ sources, is a virus that mutates readily or that exists in nature as a mixture or complex of strains, some of which consistently produce numerous stem pits and others few or no pits. The data also indicate that these strains may exist at varying levels in infected plants.

Preliminary tests of cross protection by virus from different sources.

(Continued on page 20)

TABLE 2.—Stem pitting by strains of tristeza virus that were obtained from 2 source plants, by progressive selections and transfers made in an attempt to obtain strains differing in ability to cause stem pitting.

| Source/a | Test plant/b | No. of stem pits per 10 cm of stem/c when inoculum was from indicated source/d/e of indicated test plant: In Kalpi lime: Original source | In Kalpi lime: First selection | In Kalpi lime: Second selection | In Key lime: First selection | In Key lime: Second selection |
|---|---|---|---|---|---|---|
| | | (Following selection for stem-pitting strain) | | | | |
| $T_1$ | 1 | 2 | 3 | 70 | 4 | 21 |
| | 2 | 4 | 4 | 75 | 9 | 27 |
| | 3 | **14** | 14 | 133 | **11** | **31** |
| | 4 | **26** | 123/e | 182 | **28** | **64** |
| | 5 | 29/d | | | | 71 |
| | Average | 15 | 36 | 115 | 13 | 43 |
| | | (Following selection for non-stem-pitting strain) | | | | |
| $T_2$ | 1 | 0.4/d | 0.0 | 0.0 | 0.0 | **0.7** |
| | 2 | 0.4 | 0.2/e | 0.0 | 0.5 | 2.7 |
| | 3 | 0.5 | 1.7 | 0.0 | 2.5 | 3.7 |
| | 4 | 1.3 | 3.2 | 0.0 | 4.9 | 8.9 |
| | 5 | 4.0 | | 0.2 | | 11.8 |
| | Average | 1.3 | 1.3 | 0.04 | 2.0 | **5.6** |

a $T_1$ and $T_2$ Key lime source plants were infected with the mild tristeza virus as a result of aphid transmission of the virus from a Temple orange field tree.
b Plant numbers in order of increase in average number of pits present.
c Three to 4 comparable branches were taken from each plant, the bark removed and the total number of pits and total length of peeled stem recorded, and the average number of pits per 10 cm of stem calculated. The data presented were taken on the same date and were at the following intervals after inoculation: original, 515 days; first selection, 459 days; second selection, 130 days.
d First selection based on leaf symptoms 56 days after inoculation.
e Second selection based on stem pitting symptoms 329 days after inoculation.

## Occurrence Of Mixtures Of Tristeza Virus Strains In Citrus . . .

(Continued from page 18)

—Simultaneous inoculations into each of 20 Key lime plants were made with a leaf piece from the $T_3$ source and a leaf piece from either the $T_1$ or $T_2$ source or from $T_0$ source of tristeza virus. For a 6-month period, the doubly inoculated plants showed symptoms characterstic of infection by the $T_3$ virus.

In another test, Key limes, in series of 5 plants each, were inoculated with leaf pieces from a selected $T_1$ source (11 pits) had resulted pits per 10 cm of stem, from a selected $T_2$ source with an average of 2 pits per 10 cm of stem from the $T_0$ source plant. Four months later, the first 3 Key lime plants in each group were reinoculated with leaf pieces from the $T_3$ source. At the end of 6 months, it was evident that the inoculations from selected $T_1$ source ((11 pits) had resulted in very little or no protection, those from the selected $T_2$ source (2 pits) had resulted in some protection, and those from the $T_0$ source had resulted in considerable protective action. In the last case, the plants were not stunted and had relatively few leaf and stem pit symptoms.

In a third test, 3 series of 10 Key lime plants were inoculated with single leaf pieces from $T_0$, $T_1$, or $T_2$ sources. Seven weeks later, all plants showed some leaves with scattered vein clearing indicative of infection. Four months after the first inoculation, a leaf piece from the $T_3$ source of tristez virus was inserted into each of 5 plants of each series. Records taken 8 weeks later showed that the plants inoculated only from the $T_0$, $T_1$, and $T_2$ sources had no to very few symptoms, whereas all plants in the series inoculated also from the $T_3$ source had 1 to several branches with terminal leaves showing either many or few vein and veinlet symptoms typical of those induced by the virus from the $T_3$ source. In some cases, these symptoms appeared in the leaves of top branches and in others only in leaves of lower branches. The scattered distribution of branches with leaf symptoms and variations in the intensity of the leaf symptoms suggested an erratic and unequal distribution of the virus from the $T_3$ source. Whether the strong or the mild symptoms will eventually dominate remains to be determined.

DISCUSSION—Initial evidence obtained in Brazil indicated that plants invaded by mild tristeza virus were protected against the form that induces severe symptoms (8). More recent tests carried out in Texas showed that for a 14-month period a mild tristeza virus from a Meyer lemon tree inhibited the development of severe symptoms in lime plants bud-inoculated with virus from Sueoka satsuma (17). Information in the present paper shows that tristeza virus strains may exist as mixtures in a plant and suggests that dominance of a mixture of mild strains over a mixture of severe strains may be related to such things as the time of inoculation, the stem-pitting potential or level in the former mixture, and the thoroughness of distribution of the former mixture within the plant. Recently, Costa (3) reported that plants simultaneously inoculated with the mild and severe tristeza virus strains in Brazil produced growth that represented a blending of the individual effects of both strains. In the present studies, it was found that simultaneous inoculation of Key lime plants with leaf pieces from sources with mild and severe tristeza resulted in initial symptoms for 6 months characteristic of those induced by the severe tristeza virus. When Key lime plants were inoculated first with leaf pieces from sources with mild tristeza but with different amounts of stem pitting and then inoculated 4 months later with a severe tristeza virus, the highest degree of protection was secured with the source having the lowest level of stem pitting.

Recently, Sinclair and Walker (18) in field experiments showed that cross protection between strains of cucumber mosaic virus was not complete, presumably because of a failure of any 1 strain to become thoroughly established in all tissues of the cucumber. In greenhouse experiments, they showed that at least 2 strains of cucumber moasic virus could multiply simultaneously in the same cucumber plant and that complete cross protection between strains did not occur.

The lack of complete distribution of any 1 tristeza virus strain in the Key lime test plants would appear to offer a possible explanation for the occurrence of strain mixtures and the variation in protective effects observed. The tristeza virus is considered to be a phloem virus (4). That the virus is not always equally distributed in all parts of all citrus plants has been shown by the results of tests in Brazil with transmissions from inoculated sour orange and grapefruit plants (4, 6) and in transmission tests in California (20), especially with lemon and grapefruit. Also in the course of investigations of tristeza in Florida, inoculated seedlings occasionally failed to produce symptoms even though the leaf piece used for inoculation remained alive.

Bennet (1), in a discussion of interference phenomena between plant viruses, pointed out that inoculation by means of grafts or vectors, followed by movement of the virus in the phloem, would afford opportunity for the challenging virus to come into contact with sites in which it could be established and multiply. On the basis of observed initial reactions of Key lime plants to inoculations with the challenging severe tristeza virus, it would seem that virus from the $T_0$, $T_1$, or $T_2$ sources had not completely invaded all parts of the Key lime test plants in a 4-month period, thus allowing sites for the development of the challenging virus.

Observed reactions of many citrus plant varieties and hybrids following inoculation with the tristeza virus in Brazil (4, 10) indicated a wide range in the tolerance of different plant tissues. Variations in the time required for symptom expression following inoculation suggested that the rate and amount of virus multiplication varied. In Australia (7) and South Africa (14), it has been noted that virus from sweet orange and mandarin field trees caused more severe symptoms on test plants than did virus from grapefruit, Eureka lemon, or sour orange field trees. These results indicated a qualitative difference in the tristeza virus from different hosts. Fraser (7) attributed the yellowing of test plants to a new virus and named it seedling yellows. Costa et al (6) considered the yellowing one of the symptoms caused by tristeza virus. McClean and van der Plank (14) also presented evidence that seedling yellows is a symptom of infection by the tristeza virus complex. They suggested that the tristeza virus complex has 2 components: a stem-pitting component, which alone can cause severe stem pitting in grapefruit, and a seedling yellows component that by definition must also be present to cause severe stunting and yellowing of seedlings of Eureka lemon, sour orange, or grapefruit.

The results of the present study

showed the existence of tristeza virus strain mixtures, some of which consistently caused stem pitting and others few or no pits on Key lime plants, but there was no indication that the stem-pitting strains from the mildly affected sources was combined with a seedling yellows component. In recent tests, inoculation from the $T_0$ and $T_1$ sources has caused no initial symptoms on grapefruit, sour orange, or Eureka lemon. Inoculations from the $T_3$ source did cause initial shock symptoms of stunting and yellowing on some plants. Under field conditions in Florida, abundant pitting on grapefruit stems infected with tristeza virus has been found in only a few cases. The relation of the stem-pitting strain of tristeza virus on Key limes in Florida to the strain that causes pitting on grapefruit in other parts of the world remains to be determined.

HORTICULTURAL CROPS RESEARCH BRANCH AGRICULTURAL RESEARCH SERVICE U. S. DEPARTMENT OF AGRICULTURE, ORLANDO, FLORIDA.

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Each year, the nation's farmers use nearly 7 million tons of finished steel, around 300 million pounds of raw rubber, over 17 billion gallons of crude petroleum and 22 billion kilowatt hours of electricity.

## CITRUS CANKER IN BRAZIL

(Continued from page 10)

primarily a disease of lemons which are very severly attacked while sweet orange is very seldom infected unless close to diseased lemons.

The lesions seen on lemons in Brazil also appeared different from the lesions seen on lemons in Argentina. Bitancourt's classification as Cancorosis "A" appears entirely sound, though there is the possibility that they may have both as there seem to be two types of lesions on sour orange, one type much more raised than the other. This raised type appears to be typical of Cancorosis "B" lesions seen on sweet orange in Argentina. The culture and inoculation studies being carried out by Miss Rosetti will clear this up but it is entirely possible that there are more than the two strains of this disease.

The final outcome of the work is going to depend on the amount of money made available for the work. The Instituto Biologico has done an excellent job up to now within the limitations of the funds available. The national government has allotted 20,000,000 cruzeiros for the work as mentioned previously, but at the time I left in late September this had not been actually released and its final release is likely to depend on the amount of pressure exerted by the growers and shippers in the main citrus area.

The large shippers are aware of the problem and fully realize both the potential damage to the fruit and trees and also the dangers of adverse quarantines. Whether they can rally the smaller growers to strongly support the program will be determined shortly. One thing is certain, if a strong program is not followed and eradication accomplished in this relatively remote area, it will be only a matter of time until the disease shows up in the main citrus area where it could easily be disasterous.

The above article was prepared on my return to Florida in October, 1957. Subsequently a letter has been received from Mr. Naday indicating that a strong campaign is being mounted. The following is quoted from his letter (the "Municipios" he refers to could be interpreted as counties.)

"After several meetings with growers, technical men from the Instituto Biologico and the Governor himself, a very strong campaign has been started. The Instituto Biologico received 20 Jeeps for the Horticulturists and Inspectors, 400 men from the State Police, which in 10 groups of 40 men, each under the orders of an inspector from the Instituto Biologico, will work in 10 different "Municipios" cutting down and burning ALL CITRUS TREES IN THE INFECTED AREA.

These men will be taken around in 20 trucks. The destruction will be made, starting from the limits and going toward Presidente Prudente. They also have 21 police stations on the different roads especially to survey the plant movement out from that zone. In the meantime a very through survey is being made in all the neighboring "Municipios" to establish if the canker has expanded any further, this zone is called "Zone Under Suspect." Everybody who has bought any nursery trees, citrus, or anything else, from that zone is supposed to advise the local horticulturist about it, and they are checking, as far as they can, all groves.

There has been some resistance, mainly after the Governor said that he would not give any indemnity, but this resistance comes mainly from local politicians and not growers, but we have the assurance of the Governor that the work will go on."

Citrus canners and packers are reminded to "measure carefully" ingredients which go into products made under claimed exemptions of the Federal Wage-Hour law.

## Plenty of Gift Fruit Available

Tourists may be having a difficult time finding Florida sunshine these days, but the Florida Citrus Commission says there is still plenty of it to be had in gift packages of Florida citrus fruit.

General Manager Homer E. Hooks, in a statement today, assured tourists that ample supplies of good citrus fruit, despite recent freezes and cold weather, are still available, and urged Northern visitors "to take advantage of the Florida sun sealed in each orange or grapefruit."

Hooks said many tourists had the misconception that most of Florida's good citrus fruit was lost during recent freezes.

"This is not true," he stated. "On the contrary, only a small percentage of Florida citrus has been seriously damaged, leaving a fairly large crop of good fruit available to consumers."

He said the Florida Citrus Commission had roving field inspectors checking gift fruit stands all over the State to see that all provisions of the law are met, and they found only a "very few" selling fruit that was not of fine quality.

"The very nature of their business requires repeat orders or they will not stay in business very long," Hooks said. "In order to meet this obligation, it is encumbent upon reputable gift fruit operators to see that only the finest citrus fruit is offered to the public and delivery made in sound condition."

Every precaution is being taken by the Commission and the citrus industry, he added, to see that tourists receive only the finest fruit in the best possible condition.

# Possibilities And Problems In Marketing Of Lychees

(Concluded From Last Issue)

GORDON PALMER
PRESIDENT, LYCHEE GROWERS ASSOCIATION
AT CITRUS SUB-TROPICAL INSTITUTE, LAKE PLACID

The first shipments went out from Miami on June 3 and the following week quantity production began in the center of the state. But the crop was not only small, it also all ripened at once. The last shipments were made just three weeks after the first ones started from Miami. After the fruit was gone, repeat orders poured in at a rate that indicated sales could have doubled or tripled if the fruit had been available over a normal six-week season.

This extremely short harvest this year serves to point up the complications of marketing today's lychee as a fresh fruit. The crop, always difficult to estimate, was oversold. New accounts trying the fruit for the first time were all but unable to cash in on repeat sales. Apologies and explanations were not much of a substitute.

### Experimental Processing in 1957

In pursuing experimental processing, arrangements were made for product development work by American Can Company in the canning field; by Minute Maid in the freezing field; and by the University of Florida and the University of Miami in the drying field. Other than the three basic forms of processed lychees, Crosse & Blackwell experimented with the lychee as an ingredient in jelly or preserves. The University of Miami worked with brandying the fruit and with other home recipes. The University of Florida tested some lychee extract as a flavoring for ice cream and three candy companies experimented with lychees as an ingredient for candy. The Rath Packing Company received lychees to try as a possible flavoring and tenderizing product to be cooked with meats. Finally, fruit was sent a quality bakery in New York City to see if lychees could be utilized in cakes and breads in the way that raisins are used.

It was the Association's hopes this year to establish successful techniques in these various fields so as to be prepared next year to make trial production runs, not only to establish production costs and a price structure, but also to provide a modest supply of finished products for later sampling and public acceptance tests. Since it is still too early to have had a reaction from any of these sources, the result of the over-all experimental program have not as yet been evaluated.

### Future Outlook

All in all, the members of The Florida Lychee Growers Association look forward to the future of the industry with justifiable confidence. They know they have a good fruit to start with—it has not only great glamour and romance but also good public acceptance. Most people who try it like it right away, and from the way customers reorder in increasing quantities from year to year, it seems that where it is known, its popularity continues to spread. Certainly among the Chinese who have known the fruit for centuries the only limit to consumption is an economic one. A Chinese will eat just as many lychees as he can afford to buy.

As time goes on, many of the present day problems with the fresh fruit will be worked out. Horticultural progress can be expected to extend the harvesting season, by better cultural methods and by the development of new varieties. After all, the mango and the avocado were short season crops in Florida not so many years ago. Better preservation methods will likewise lengthen the time the fresh fruit is available each year. Simple refrigeration alone, for instance, has been shown to give the fresh fruit a substantially longer shelf life.

These foreseeable developments toward increasing the marketability of the fresh fruit coupled with the untapped possibilities of the lychee in processed form all add up to an optimistic future outlook. There is a long pull ahead and much to do. Fortunately, being organized as a strong Association greatly strengthens the grower's prospects of getting the job properly done.

## UPDIKE, SPELLER NAMED MINUTE MAID DIRECTORS

Election of two members to the Minute Maid Corp, board of directors was announced today by John M. Fox, president.

Chosen to the board yesterday at the annual stockholders' meeting of the Orlando-headquartered citrus processing company were Archibald R. Updike, Sr., Lake Wales, and William E. Speeler, Winter Park.

Updike, who has been president of Alcoma Packing Co., Inc., Lake Wales, since 1941, also is a director and member of Florida Orange Marketers, Inc. A graduate of Princeton University in New Jersey, Updike has been active in Florida citrus, cattle and general farming since 1924.

Speeler joined Minute Maid in 1949 as company secretary. In 1955 he was elected a vice president. Speeler was a 1939 graduate of Harvard Law School and was associated with the New York law firm of Cravath, Swaine and Moore and the Fairchild Engine and Airplane Corp. before coming to Minute Maid.

He lives with his wife, Barbara, and a daughter at 1060 Azalea Pl., Winter Park.

"Why, Mr. Baxter! It *is* a small world, isn't it?"

# USDA Scientists Develop New Use For Fruit Juice Concentrates

A new method of making jelly, using fruit-juice concentrates rather than single-strength juices, has been developed by U. S. Department of Agriculture scientists. It is a continuous process, which offers advantages in operational economy and quality control over the traditional batch process.

The method was developed by J. D. Ponting, D. W. Sanshuck, and J. E. Brekke of USDA's Western Utilization Research and Development Division at Albany, Calif. Their purpose was to find a new use for concentrates, which offer promise as new products of fruit processing plants in production areas.

Instead of cooking single-strength juice in kettles with sugar and other ingredients until enough water is evaporated to make jelly, these workers propose pumping measured amounts of cold fruit-juice concentrate, cold pectin solution, and hot sugar syrup together to make jelly continuously. The result is a jelly of good color and flavor undamaged by look cooking. It is not necessary to heat the jelly to a temperature higher than 180 degrees F., required to pasteurize the product.

Using this process, the USDA researchers have produced jellies of several flavors. A report of their work has been prepared for interested manufacturers.

In making jelly by the continuous process, the hot syrup is prepared and held in a tank at just below the boiling point. A cold pectin solution is prepared in a second tank. The concentrated juice, with flavor essence and fruit acid added if desired, is held in a third tank. Metering pumps force these three ingredients together in a mixing pipe, one portion of which is steam-jacketed to bring the temperature of the jelly mixture up to 180 degrees F. for filling into glasses.

Availability of high-quality fruit-juice concentrates is the key to commercial use of the new jelly-making method. The concentrates—natural juices from which some of the water has been removed—are now produced commercially in limited quantities by low-temperature concentration under high vacuum. Some of the natural fruit flavor vaporizes during concentration but it can be collected and added back to the final product.

By using such essence-fortified fruit-juice concentrates in continuous jelly making, it is possible to make jellies of excellent flavor and color, because the temperature of the product is kept below boiling.

Natural juice and flavor concentrates can be frozen and shipped to jelly makers at considerable savings in storage and shipping charges compared with the cost of handling single-strength fruit juices. The concentrates can also be depectinized and clarified to give jelly makers a superior product, the USDA researchers say.

# The LYONIZER

COMPILED BY THE LYONS FERTILIZER COMPANY

## Reports Of Our Field Men . . .

**SOUTH HILLSBORO & NORTH MANATEE COUNTIES**
**Jack Baxter**
**1510 South Habana**
**Tampa — Phone 82-6554**

Although on the surface my territory looks like South Georgia, a closer examination reveals plenty of farming activity. Many people are planning their spring crop with enthusiasm and hopefulness. It is hoped that strawberries will still put out a late crop that will be a money maker now that all the other growing sections are frozen over.

Fruit prices are very good now and I believe will be better for valencias. It is my opinion that many growers in my section will come out better price wise than if there had been no freeze.

**HIGHLANDS AND POLK COUNTIES**
**J. K. Enzor, Jr.,**
**P. O. Box 1384 Winter Haven, Fla.**
**Phone Cypress 3-4716**
**R. E. Lassiter, Jr.,**
**1168 Lakeshore Blvd.**
**Lake Wales, Fla.**
**Phone 3-3813**

The time of this writing is only one day away from our last cold wave. It is difficult to tell as yet how much more damage has been done by this freeze. Over the past few weeks groves which were not defoliated too badly from the early freezes have lost some foliage from frequent frosts.

Our growers are beginning the spring fertilizer application at this time. Where the trees have been hurt by the cold we are recommending that a complete fertilizer be applied rather than straight nitrogen alone. We feel that the use of secondary elements will also be most important in these blocks this spring.

On trees that were defoliated copper sprays will be important in preventing considerable melanose infection on the new foliage. Where large acreages are to be treated it might be advisable to first spray trees that were 15 to 50 percent defoliated. Where there was more than 50 percent defolication, delay the application until the young leaves are one-half their normal size. A post-bloom copper will be necessary to protect the fruit from melanose even though a pre-bloom copper was applied.

Growers should be on the lookout for mite populations, especially six-spotted mites, before spraying. If six-spotted mites are found, it is advisable to use Systox, Ovex, or Aramite. These materials applied now will be helpful in preventing a spring build up of six spotted mites. If lime-sulfur is used it should not be used with copper compounds.

**SOUTH HILLSBOROUGH AND MANATEE COUNTIES**
**Eaves Allison**
**P. O. Box 365, Sarasota, Fla.**
**Phone Fulton 8-2611**

Everything has already been said about this winter that can be said. There is no use taking up any more space criticizing it! Howsomever, we CAN let some lessons soak in that we already knew.

For the citrus grower, we have arrived at some pretty definite conclusions: Bring your trees — young and old — to dormancy as early in the fall as possible. Feed them so as to eliminate deficiencies as much as possible. Build up those elements that increase their cold resistance. Your county agent or your Fertilizer Field Representative can help you here, if you are in doubt.

For the vegetable grower: Keep up your secondary plant food elements in the soil. You already know how to lay out your rows and plant your beds. BUT — after you seed in the field have a covered seed bed — heated if necessary — to be an ace-in-the-hole (whatever that means) for just such a winter as we have almost gone through. For four years you will be wasting your money — but the fifth year will pay off those four and four more!

Grove owners really do not have much to worry about now — their frozen crop already is worth more than their unfrozen crop was. And the vegetable grower has another three months to go before the whole story can be told.

At least we are not as bad off as the Indians were when the buffalo disappeared. And that good Lyons Fertilizer will help you come back!

**NORTH CENTRAL FLORIDA**
**V. E. Bourland**
**Winter Garden, Fla.**
**Phone 107**

Feb. 13 we had our fifth freeze since Dec. 12. At this date which is Feb. 15 we are still having rainy, windy, and cold weather which has been very hard on all citrus and truck, and has the growers at a loss as what to do. Most of the citrus growers are trying to get a nutritional spray on trees, following with some quick nitrogen, while some of the growers haven't even had their groves worked, trying to leave trees as dormant as possible until spring gets here, they feel after the full moon which comes early in March, is early enough to be safe. Three new growths have already been killed on some trees.

Midseason fruit is still being harvested, and some Valencias are being moved.

Lots of young trees that were banked early have been banked as many as three times on account of the wind being so strong it blew away the bank leaving roots bare.

**SOUTH POLK, HIGHLANDS, HARDEE, DeSOTO AND SARASOTA COUNTIES**
**C. R. Wingfield**
**Avon Park, Fla.**
**Phone Glendale 2-81881**

There is not much we can say except "Brother It's Been Cold Outside." Certainly Florida has never witnessed as long and as continued a cold as we have had since early in December. And it has covered the entire state almost every week.

Many of the groves which looked as if it had gotten by the December 12-13 cold has been continuously hurt until there is no doubt there will be much wood damage. But until a flush of growth it will be rather hard to say just how much damage has been done. I believe much more fruit was damaged than first thought but we must remember each cold has added to the previous damage. Heavy winds have caused much fruit to fall to the ground.

The Citrus grower, Cattlemen and Vegetable grower have all had their troubles and all are working hard to bridge over this disastrous period.

## *Uncle Bill Says:*

Feller told me the other day there had been more damage done by pessimistic conversation than had been done by all the cold and all the rain this winter . . . could be the feller had sumpin', 'though it can't be denied they has been damage . . . but it looks now that we've bin through the worst of it . . . and quicker than a lot of folks think the growers of this state will be hard at work repairin' any damage done and gittin' ready fer another season.

Reason we say this is 'cause fer more years that we want to admit to we bin watching the growers of Florida comin' out from under a lot of different troubles and goin' ahead and makin' their groves and fields produce even bigger and better crops than before.

Fact is, we don't know of any group of folks anywhere who are as good fighters as are our own Florida growers . . . drouth, cold, insect pests, economic conditions that has been bad, has all bin taken care of and the citrus and vegetable business is today more important than it was before any of these troubles hit us . . . and this last blast which the weatherman levelled at us isn't goin' to find this bunch of men licked . . . not by any means.

As a matter of fact Florida growers is a very special type of folks . . . most of 'em figger that the recent freeze, fer instance, indicates that the growers, compared with other folks, is purty lucky . . . one bad year in twenty they think, and properly so, is a heap better average than most folks in any other business can claim . . . in addition to which the growers jist won't admit to bein' licked, which is why growers in our state has built up such an important industry.

Right on this very day you'll find growers everywhere workin' like mad to git their groves back in the best possible producin' condition so that, after gittin' the most out of their crops this season they can look ahead to the next one as a successful one, if they git their groves back in order quickly . . . which is jist what the big majority are doin' right now . . . all of which proves that you can't keep a good man down!

## Phosphatic Insecticides Mixed With Oil Emulsions For Scale Control And Their Effect On Fruit Quality . . .

(Continued from page 8)

oil was included in this experiment. Oil emulsion at 1.3 percent oil was used as the standard for comparison (Table 3).

Four months after treatment the parathion-oil mixture was the most effective of all treatments for purple scale control. Malathion-oil mixtures at concentrations of 1 and 1-½ pints of Malathion per 100 gallons were slightly less effective than the standard oil treatment but 2 pints were more effective. All Malathion-sulfur mixtures were less effective than the standard. The Chlorothion-oil mixtures were more effective than the standard treatment and there was very little difference in control between the three concentrations. The mixtures of Chlorothion and sulfur was the least effective.

Red scale control was more effective with the parathion-oil, Malathion-oil and Chlorothion-oil treatments than the standard oil treatment. The mixture of 1 pint of Malathion per 100 gallons with sulfur was not as effective as the standard oil treatment but comparable control was obtained with the higher concentrations. Chlorothion at 1-½ pints plus sulfur was not as effective as the standard or where it was supplemented with oil.

Recently an 87 percent formulation of emulsifiable Malathion, containing 8 pounds of active ingredients per gallon, has been introduced. This formulation, mixed with .7 percent oil was compared with the 57 percent emulsifiable Malathion and with the 25 percent wettable powder. Oil at 1.3 percent was used as a standard (Table 4).

In this experiment, results were not consistent at the lower dosages, but where approximately .75 pounds of Malathion (technical) was used the 87 percent emulsifiable and the 25 percent wettable powder were more effective than the 57 percent emulsifiable formulation. In several taining 8 pounds of active ingredients other experiments, the 87 percent emulsifiable Malathion was on a par with the 25 percent wettable, and somewhat more effective than the 57 percent formulation when mixed with a low concentration of oil.

Chaff scale, **Parlatoria pargandii** (Comst.), was not a factor in most of the groves; however, in on experiment there were enough present to be considered. A 25 percent Malathion at 4 pounds and at 5 pounds respectively per 100 gallons was not effective, but Malathion at either 2 pounds or 3 pounds per 100 gallons plus .7 percent oil was more effective than 1.3 percent oil.

Trithion, O,O-Diethyl S-p-Chlorophenylthiomethyl phosphorodithioate, was reported by Johnson (3) to be effective for the control of the purple mite. Since this material is a phosphatic compound it was tested for the control of scale. Three pounds of a 25 percent Trithion wettable powder per 100 gallons was not effective against either purple or red scale. In one experiment 1 pound of the 25 percent wettable powder plus .43 percent oil was fairly effective but where the oil concentration was reduced to .25 percent oil, the mixture was not effective. However, some tsets with this material in different formulations have not been completed.

### PHYTOTOXICITY

Parathion and oil mixtures have caused heavy leafdrop at times. When leafdrop did occur there was a heavier drop of leaves following a parathion-oil mixture than where oil was used alone. It has not been determined whether the Malathion-oil mixture will cause a leafdrop under adverse conditions since no unusual drop of leaves has occurred with any experiment in which the Malathion-oil mixture was included.

### FRUIT QUALITY

In three different experiments

**Table 5**
**Effect of Various Insecticides on Internal Quality of Grapefruit**

| Materials in Active Ingredients per 100 Gallons | Percent | | Ratio |
|---|---|---|---|
| | Soluble Solids | Titrable Acid | Solids to Acids |
| Sprayed July 2, 1955 | | | |
| Parathion .25 lb., Sulfur 5 lbs. | 8.84 | 1.15 | 7.72 |
| Parathion .15 lb., Oil emul. 0.7% | 8.73 | 1.18 | 7.38 |
| Oil emul. 1.3% | 8.60 | 1.17 | 7.38 |
| LSD 5% | NSD | NSD | .252 |
| LSD 1% | | | .333 |
| Sprayed July 10, 1956 | | | |
| Malathion 1 lb., Sulfur 5 lbs. | 8.48 | 1.27 | 6.78 |
| Oil emul. 0.8% | 8.18 | 1.22 | 6.76 |
| Oil emul. 1.0% | 8.06 | 1.24 | 6.55 |
| Oil emul. 1.3% | 7.99 | 1.23 | 6.51 |
| LSD 5% | .177 | NSD | NSD |
| LSD 1% | .234 | | |
| Sprayed July 12, 1956 | | | |
| Parathion .25 lb., Sulfur 10 lbs. | 8.52 | 1.23 | 6.96 |
| Parathion .15 lb., Oil emul. 0.7% May 8 | 8.00 | 1.22 | 6.60 |
| Parathion .15 lb., Oil emul. 0.7% July 12 Oil emul. 1.3% | 7.96 | 1.15 | 6.99 |
| LSD 5% | .215 | .068 | .349 |
| LSD 1% | .286 | .091 | .464 |

**Table 6**
**Influence of Oil and Parathion on Fruit Color as Determined from Trees Sprayed September 18 and picked November 16, 1951.**

| Materials as Active Ingredients per 100 Gallons | Percent well to fairly well colored | | | |
|---|---|---|---|---|
| | Seedy Grapefruit | | Pineapple Oranges | |
| | Hours in Coloring Room | | | |
| | 45 | 72 | 45 | 72 |
| Oil emul. 1.5% | 60 | 68 | 40 | 54 |
| Oil emul. 1.3% | 64 | 68 | 68 | 62 |
| Oil emul. 0.5%, parathion .15 lb. | 82 | 96 | 90 | 92 |
| Oil emul. 0.4%, parathion .15 lb. | 90 | 94 | 82 | 96 |
| Sulfur 5 lbs., parathion .25 lb. | 100 | — | 100 | — |

analysis of Ruby Red grapefruit juice was made where varying amounts of oil was applied (Table 5). In each of the three experiments, the soluble solids were lower where oil was used than where either parathion or Malathion were used without oil. Where oil was used alone or mixed with parathion there was a trend towards lower solids as the concentration of oil was increased, but the differences between 1.3 percent oil and lower concentrations were not always significant. There was also a trend to lower acid where oil was used.

Fruit color is an important factor where crops are sold on the fresh fruit market. The effect of oil on fruit color is even more important than its effect on depressing solids. In Table 6 are recorded data on the effect of varying amounts of oil on degreening grapefruit and Pineapple oranges. Although the oil sprays were applied late in the season, (September 18, 1951) the effect of the higher concentrations of oil are conclusive. The degreening of both grapefruit and oranges were retarded to a marked degree where either 1.5 per cent or 1.3 per cent oil was applied. After 72 hours in the coloring room, 68 per cent of the grapefruit was colored where the higher concentrations of oil had been applied, compared to an average of 95 per cent colored fruit from plots sprayed with the lower concentrations. Pineapple oranges were affected the same as were grapefruit. In 1955, Dr. W. Grierson[1] inspected Ruby Red grapefruit from oil-sprayed plots and reported (unpublished date) that the best color and more pronounced blush, subsequent to degreening, was on fruit from parathion-sprayed plots. The next best color and blush were on fruit sprayed with .7 per cent oil plus parathion and the poorest color with very little blush occurred where 1.3 per cent oil was applied. In 1956, Grierson reported (unpublished data) that the difference in color and blush of Ruby Red grapefruit were not so distinct between high and low concentrations of oil. However, best colored fruit was from plots sprayed with Malathion.

## DISCUSSION

Results of experimental work presented in this paper and unpublished data indicate that Malathion at .5 or .75 pound of technical Malathion per 100 gallons plus .7 per cent oil is effective in the control of purple and red scale, but not as effective as .15 pound of parathion plus .7 per cent oil. The reduced dosages of Malathion plus .5 per cent oil was not as effective as Malathion supplemented with .7 per cent oil, but very substantial reduction of scale infestations resulted from these combinations. Of the three formulations of Malathion tested with .7 per cent oil, the results indicate that 2 or 3 pounds of the 25 per cent wettable or ½ to ¾ pint of the 87 per cent emulsifiable liquid per 100 gallons are slightly more effective than 1 pint of the 57 per cent emulsifiable. Chlorothion was effective when supplemented with .7 per cent oil.

The soluble solids in the juice of fruit was not affected by parathion or Malathion, but where these materials were supplemented with .7 per cent oil, the solids were lower, but not as low as with 1.3 per cent oil.

Fruit color has been best from plots sprayed with either Malathion or parathion used without oil. Degreening was retarded more with 1.3 per cent oil than with .7 per cent oil.

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## FLORIDA CITRUS COMMISSION MOVES TO AID CATTLEMEN

The Florida Citrus Commission is working in close cooperation with the Florida Cattlemen's Association to help alleviate some of the problems of feeding of cattle.

There are many growers throughout the state who have fruit on the ground who are willing to allow the cattlemen to utilize these drops for supplemental feeding. The Florida Citrus Commission is working as a clearing house for the growers, while the Florida Cattlemen's Association is likewise working with the cattlemen.

# Citrus Studies At Fla. Southern College

By William R. Lyle
Head Citrus Department

Three separate plans of study are now being offered to students enrolled as citrus majors at Florida Southern College in order to give them a more complete knowledge of the industry's main phases of operation.

One plan of study — the most popular program among the 72 students studying citrus at Florida Southern — was designed for those interested in Citrus Production and is referred to in the college catalogue as the Plan-A program.

The second, or Plan-B Program, is suggested for those who are primarily interested in packing, processing and marketing of citrus fruits. These curricula lead to a Bachelor of Science degree. The Plan-C program, a two-year course in citrus production, has been worked out for those enrolled as special students.

To secure diversification in his work and to obtain a well-rounded general education, the student must, in addition to meeting the specialized requirements for a major in Citrus Studies, fulfill the general requirements of the college for a B. S. degree.

Besides the required and optional courses in citrus, 44 semester hours must be completed in the following basic courses or subject areas: English, literature and speech, (15); mathematics, (6); social sciences and humanities, (18); applied arts, (3); and physical education, (2).

To qualify for a B. S. degree in Citrus Studies under the current citrus production program, the student must complete a total of 128 semester hours with a minimum of 30 hours in citrus, eight in chemistry, and eight in botany and zoology. A six-hour course in basic horticulture is scheduled for the first year and six hours of citrus culture in the second year.

The majority of citrus courses are scheduled in the third and fourth years since the citrus major devotes most of his first two years to the required general courses as well as certain fundamental courses in chemistry, botany, and zoology. Such courses as soils and fertilizers, citrus insect and disease control, citrus nutrition, grove management and citrus marketing are scheduled for the third and fourth years. Citrus packing and fruit processing are also scheduled for the upper division. The instructional staff of the citrus department counsels with the citrus major in the selection of elective subjects and optional citrus courses to insure that the program correlates with his aims and plans.

Because the college is located in the very heart of the citrus growing and packing and processing area of Florida, the citrus department is in the fortunate position of being able to maintain close association with outstanding individuals and organizations in these fields. Every effort is made to keep the citrus courses up to date and practical as possible.

The department limits its work to instruction in specialized and practical courses in citrus studies and a few other selected subjects in sub-tropical horticulture. Research projects and results of the several state, federal, and grower organizations are presented to the students without prejudice or bias.

All academic instruction is supplemented and given additional emphasis and clarity by frequent and regular scheduled field trips to nearby commercial citrus groves, packing and canning plants, fertilizer houses, etc. A congenial relationship exists with the government and citrus industry organizations in the Lakeland-Winter Haven area, such as the Florida Citrus Commission, State Department of Agriculture Inspection Service, Citrus Experiment Station, State Plant Board, Florida Citrus Mutual, Soil Science Foundation, and other. The citrus majors visit these organizations in order to become more acquainted with their highly important work.

The citrus department, now in its 11th year, is housed in a wing of the new Polk County Science Building. The citrus section is completely modern and well-equipped for instructional work in citrus studies and horticulture, with classrooms and laboratories for insect and disease control. The other departments in the Science Building also have extremely well-equipped laboratories for instruction in chemistry, biology, plant physiology, plant pathology, and entomology, pre-requisites for citrus majors.

The citrus department now consists of five members — two full time teachers and three industry specialists who have been engaged by the college as visiting instructors. A number of specialized citrus courses are offered in the evenings in order that individuals who must continue in their regular employment may have the opportunity to further their study in this field.



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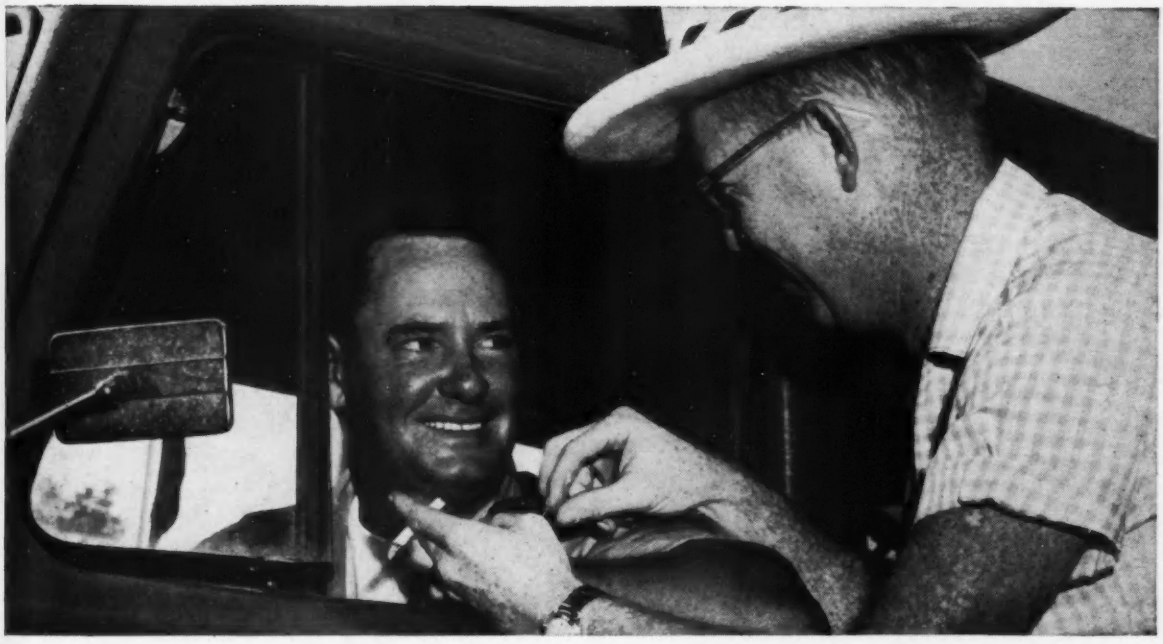

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